MUNITIONS BY AUTOMOTIVE MASS PRODUCTION—APRIL, 1941

MACHINERY

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Some unusual methods used by Chrysler Corporation in manufacturing thousands of trucks for the United States Army will be described in the leading article in May MACHINERY. Other subjects of interest will deal with the maintenance of dies for greater production; methods employed in producing airplane propellers; cutting threads close to a shoulder; ingenious mechanisms; and various examples of tool and fixture design.

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Number 8

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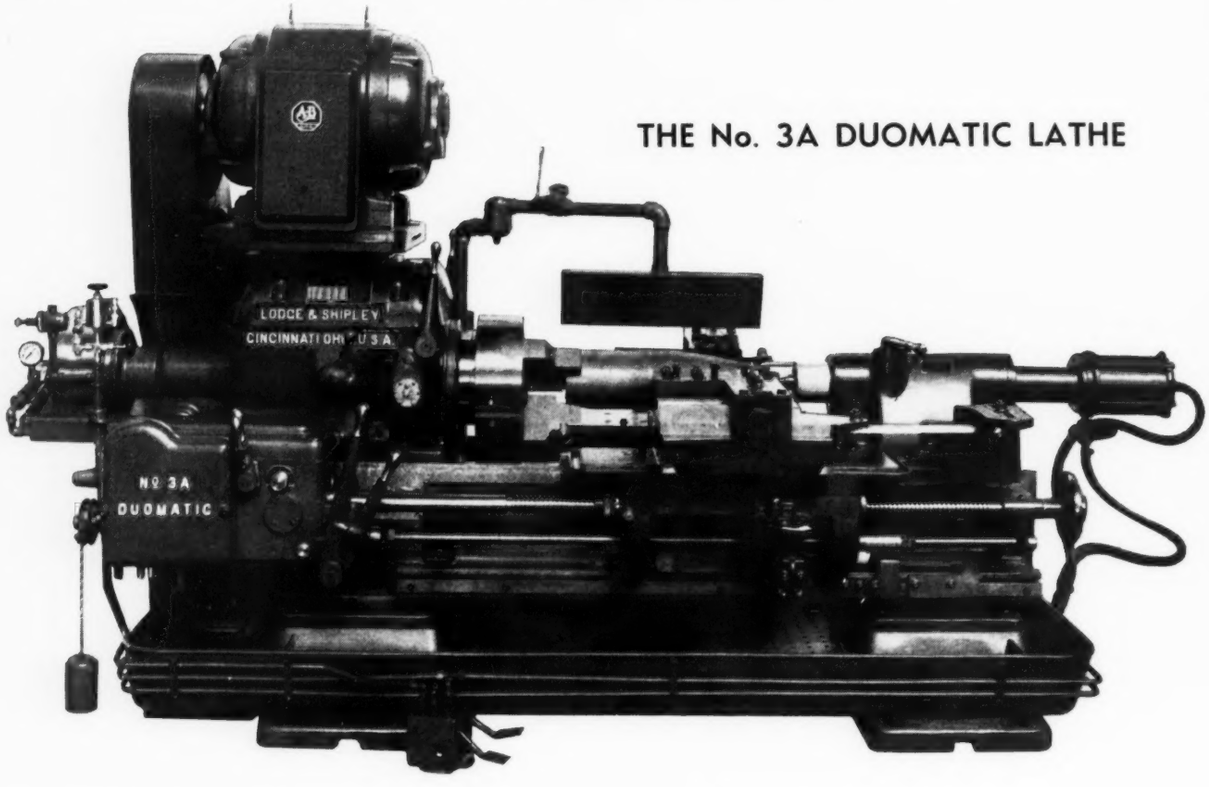
The No. 3A Duomatic Lathe illustrated below is now being furnished to shell contractors for rough and finish turning operations on the 75, 90, 105 and 155 MM shells. The lathe has a powerful headstock, a wide bed, and an independent front and rear carriage having a cross slide that can be swivelled to any desired angle for power feed and power forward and return traverse. The tailstock spindle with built-in revolving center is pneumatically operated along with the three jaw compensating chuck and the three segment expanding arbor used at the headstock end. The No. 3A Duomatic Lathe is driven by a 40 H.P. Motor.



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MACHINERY

NEW YORK, APRIL, 1941

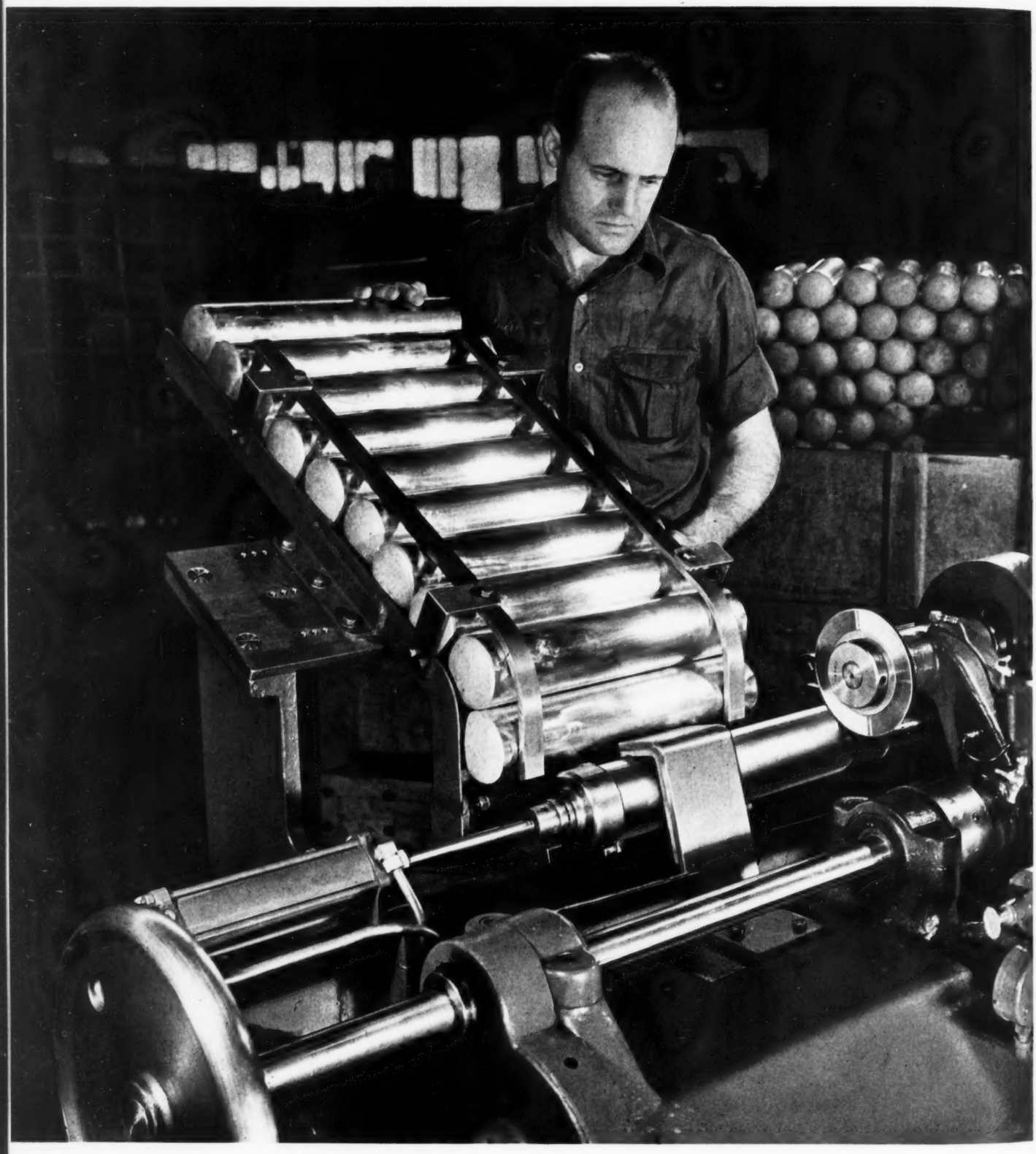
Volume 47 Number 8

Munitions by Automotive Mass Production Methods

THE automotive industry has undertaken to produce a large proportion of the munitions of war required by the Government under our National Defense Program. Orders totalling considerably more than one billion dollars have already been awarded to this industry for the manufacture of mechanized tanks, army trucks, shells, cartridge cases, machine guns, aircraft and marine engines, fire control instruments, and so on.

The vast research, engineering, and production facilities of the automotive industry are being directed toward producing these munitions of war by the intensive application of the mass production principles that have made the industry famous the world around. Important strides have already been made toward that end, as shown by the articles presented in this number of MACHINERY. Thousands of army trucks and shells, hundreds of aircraft and marine engines, and considerable quantities of other munitions have already been delivered by the automotive industry to the War and Navy Departments. These are but drops in the bucket compared to the total output of munitions which the industry will achieve during the present year.

Chrysler Cooperation



for National Defense

The Construction of the World's Largest Arsenal for the Mass Production of Military Tanks; the Production of Over 70,000 Army Trucks; and the Manufacture of Artillery Shells—These are Some of the Major Projects of the Chrysler Corporation for the National Defense Program

By CHARLES O. HERB

THREE major projects have already been undertaken by the Chrysler Corporation that constitute an important step toward the successful fulfilment of the National Defense Program. Others, including manufacturing fuselages for Martin B26 bombers, are being arranged. The most outstanding of these is the construction of the world's largest arsenal for the mass production of military tanks. This arsenal will cost approximately $20,000,000. It will be 1380 feet long by 500 feet wide. Ground was broken for the erection of this factory in September, 1940. Machines are already in operation, and it is expected that by early autumn of this year the arsenal will be in full production, with five 25-ton tanks rolling off the assembly lines every day on a one-shift basis.

This will be a remarkable achievement, considering the size of the factory and administration buildings which had to be planned and erected, the great number of machine tools which had to be designed, as well as installed and tooled up, and the large number of men who will have to be trained for the manufacture and assembly of the tanks themselves. The Government has already placed a contract with the Chrysler Corporation for the production of 1000 tanks at a cost of approximately $33,500,000.

The second major project is more directly in line with the regular manufacturing activities of the corporation. It consists of building thousands of army trucks of various types. Up to February 1, orders had been accepted for supplying more than 70,000 trucks, and they are being turned out at the

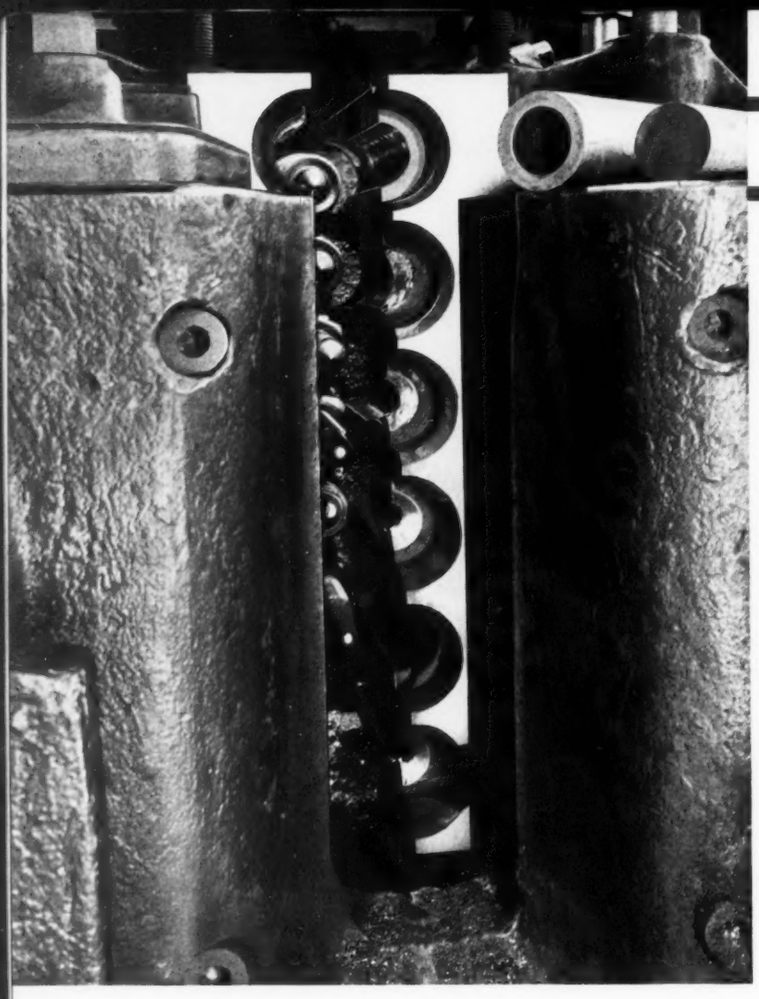
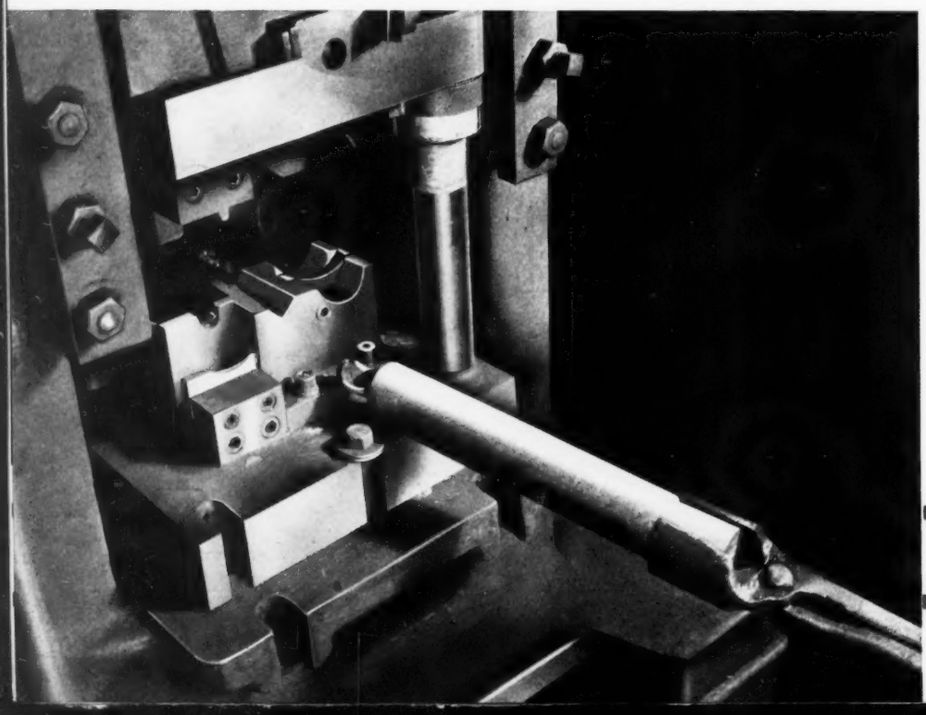


Fig. 1. Close-up View of the Dies and Punches Used in Forging 75-millimeter Shells in a Chrysler Plant

Fig. 2. Die Equipment Used for Cutting off First Shell of Each Bar and Forging a Tong-hold on the Remaining Stock



rate of about 300 a day. These orders have a total value of $69,000,000. Unusual methods employed in producing these trucks will be described in an article to be published in May MACHINERY.

The third major project of the Chrysler Corporation necessitates the development of methods for the manufacture of a product far afield from the regular products of an automotive concern, namely, 75-millimeter artillery shells and cartridge cases. A factory section in the Detroit area equipped entirely for this purpose is nearing completion on an educational order of 10,000 shells and cartridge cases. The modern methods that have been adopted in that plant will form the subject matter of this article. The plant is so laid out that production could be greatly increased over night by the installation of additional machines in spaces provided for them in the production lines.

Modern Methods Insure Shell Forgings of High Quality

The steel for the manufacture of the 75-millimeter shells is received at the plant in long bars, which are nicked by hacksaws to the length required for forging two shells, an extra amount being allowed to provide a tong-hold for use in forging the second shell. After being nicked, these billets are broken off under a press. Severe metallurgical specifications have been placed by the War Department on the chemical and physical characteristics of steel used for shell forging.

Prior to the forging operation, the bar stock is heated to between 2200 and 2300 degrees F. for a length sufficient for forging the first shell. This is done in a gas-fired furnace. Then the heated stock is placed successively in the six die cavities of the

forging machine shown in Fig. 1, which transform it from a solid bar into a hollow shell, as indicated by the pieces lying on top of the machine.

While in the first die cavity, at the top, the forging is upset to form a flange for locating the front end of the forging in the following die cavities, and the piercing of the bar is commenced. In the second, third, and fourth die cavities, the punches progressively pierce the shell farther and farther to approximately the finished size. The punch that enters the fifth die cavity shears off the shell flange. Finally, the punch for the sixth die cavity finish-forms the shell cavity to size with a spherical inner end that joins a taper blending with a straight wall that extends to the open end of the shell.

The forged shell cavity must be extremely smooth, as no subsequent machining is performed on this surface. The cavity must also be free from scale and pit marks, and must be to size within a total tolerance of 0.020 inch.

When the first shell has been forged from a bar, the forging is immediately placed in the die of the power press illustrated in Fig. 2 for cutting off the forged shell and forging a tong-hold on the remaining stock. Cutting off is performed on the left-hand side of the die; and as this operation is completed, a steel blade several inches in front of the shear makes a slight mark on the under side of the stock to indicate the amount that is to be used up in forging the tong-hold.

The hot end of the bar is then placed in the right-hand die cavity for swaging the stock to a reduced diameter. Two strokes of the press are required for this operation, the stock being revolved through 90 degrees between the strokes. Then the reduced stock section is placed in the vee in the center of the die for forging to a square cross-section with

Fig. 3. The Nose is Cold-formed on the Open End of the Shells by the Application of a Power Press as Shown

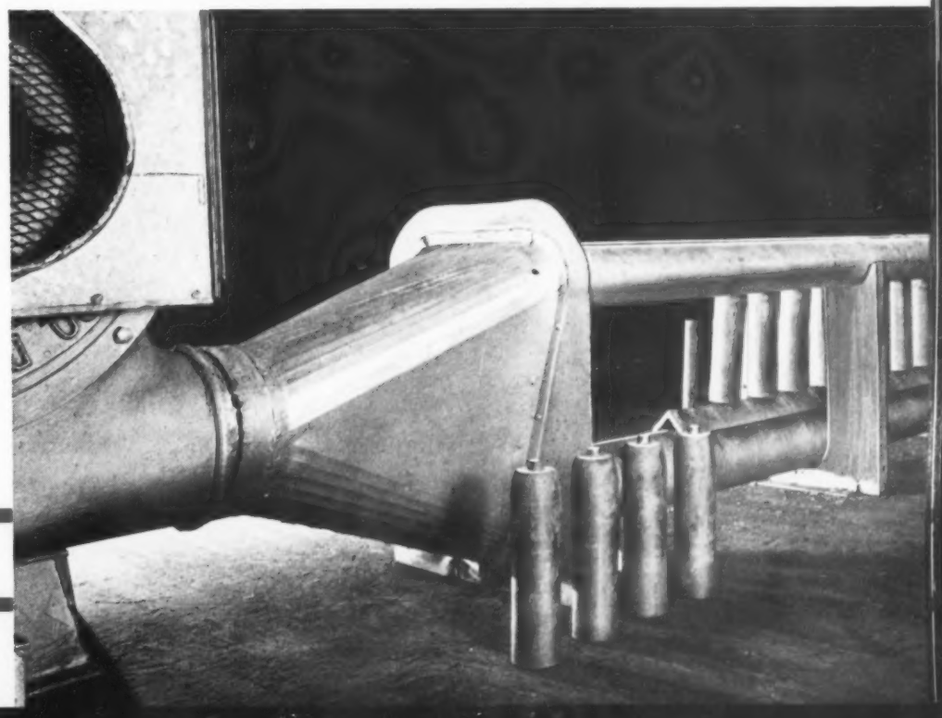


Fig. 4. Air-blowing Equipment Used to Control the Cooling of the Shell Forgings and Thus Insure Required Hardness

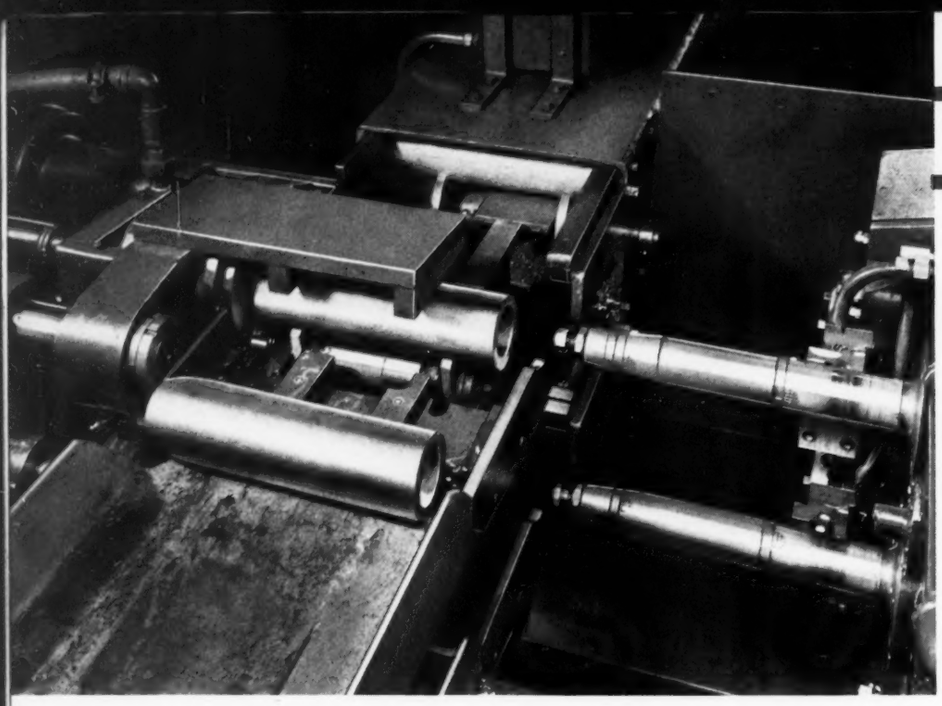


Fig. 5. The First Machining Operations on the Shells Consist of Center-drilling the Closed End and Facing the Open End to Length

two more strokes of the press. The stock for the second shell is then laid aside to cool completely before being heated ready for forging. When the second shell from any bar has been forged, the tong-hold is cut off in the same press.

Controlled cooling of the forged shells is employed to insure the specified hardness of all shells, despite metallurgical differences in the various lots of steel from which they are made. This factor has been found by the corporation to be of utmost importance in successful shell manufacture. From the cutting-off press, the hot forgings are immediately placed on the vertical pipes of an air-cooling unit, as illustrated in Fig. 4.

This unit is long enough to accommodate sixteen shells. Air supplied by a blower at the left-hand end of the equipment is delivered to the inside of the shells through the pipes over which they are placed, which are about 4 inches shorter than the length of the shell cavities, as will be apparent from the illustration. Air is also directed downward on both sides of the shells through rectangular slots, about 2 inches long by 3/8 inch wide, in two pipes that extend along the tops of the shells on both sides, only one of these pipes being visible in the illustration. Air eddies are set up completely around each shell and down its full length.

The amount of air directed on any group of shells depends upon the steel from which they were made. With each new lot of steel, experiments are made on a few shells to determine the amount of air flow that is necessary to obtain the specified hardness of 217 to 223 Brinell. The air flow is varied from several hundred cubic feet per minute up to five times that amount.

Shot-Blasting, Centering, and Rough-Turning the Shells

The next operation consists of shot-blasting the shell cavities with the shells revolving in upright positions, so as to clean out any slight irregularities that may exist after forging and cooling. Then the shells go to the double-end machine illustrated

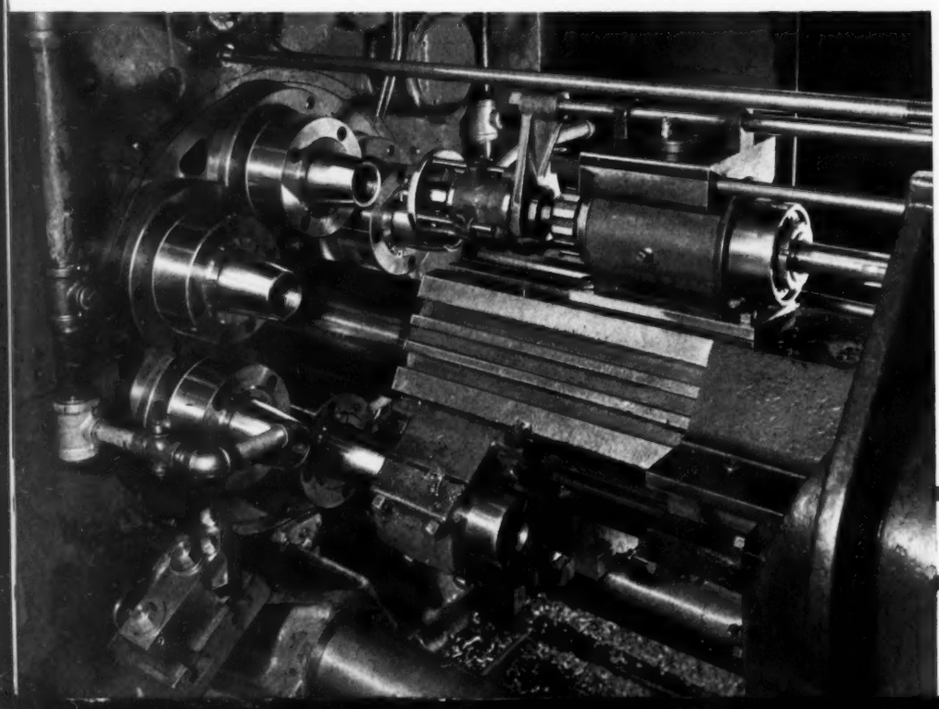


Fig. 6. Six-spindle Automatic Tooled up for Counterboring, Recessing, Threading and Chamfering Operations on the Open End of the Shells

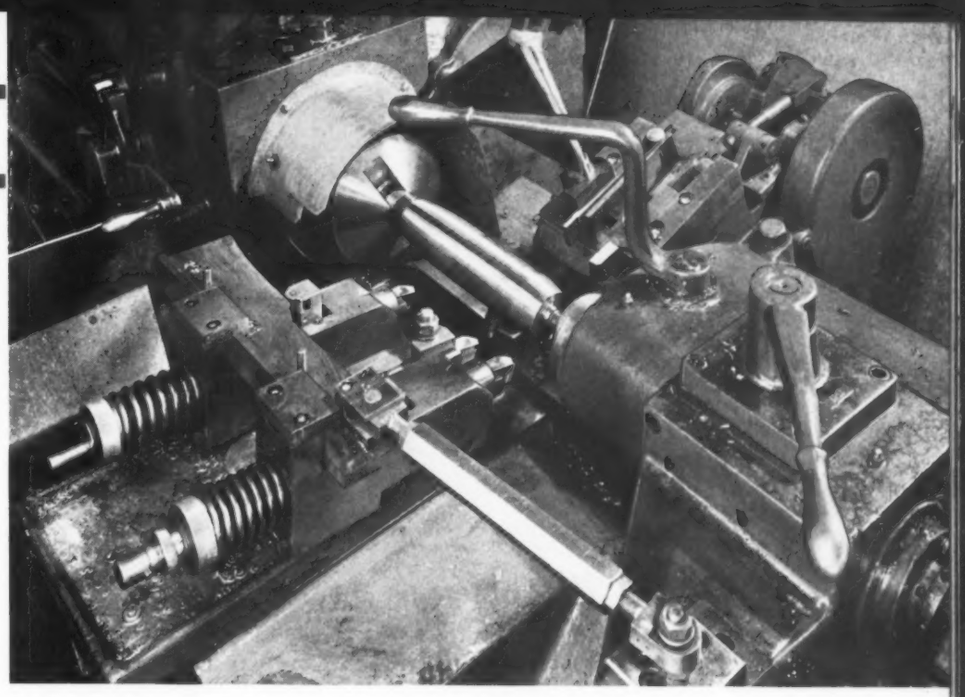


Fig. 7. Automatic Lathe and Tooling Equipment Used for Performing Finish-turning, Facing, and Grooving Operations on the Shells

in Fig. 5, where they are simultaneously faced on the open end and center-drilled on the closed end. Two shells are machined at one time, the magazine being provided with two chutes that carry the shells forward into line with the arbors seen at the right.

With two shells held in position by means of dogs on the magazine mechanism, the left-hand tool-head advances toward the right to push the shells on the arbors. The latter are both provided with two sets of jaws which are expanded radially to grip the shells from the inside and hold them securely for the operation, assuring accurate alignment of the center-drilled hole with the center line of the cavity. The shells being thus located and clamped, the left-hand head continues advancing to perform the center-drilling. At the same time, a slide seen at the extreme right moves radially toward the work to bring two tungsten-carbide tools into position for facing the ends of the shells.

At the completion of the operation, the left-hand tool-head automatically recedes, pulling the shells off the arbors and into position on the chute seen in the foreground of the illustration, down which they roll into a container when the magazine dogs are released. Adjusting screws on the front ends of the arbors provide stops against the spherical inner end of the cavities, insuring accuracy of the facing cuts.

Rough-turning of the shells is next performed on automatic lathes tooled up somewhat similarly to the machine illustrated in Fig. 7, which is employed for finish-turning. Rough-turning is one of the most important machining operations, due to the final concentricity requirements, and to the fact that, in the boring and threading operations on the nose end, the shell is located from the rough-turned surface.

The Shell Nose is Cold-Formed in a Press

After rough-turning, a nose is cold-formed on the open end of the shell by the use of the power press illustrated in Fig. 3, which forms the upper

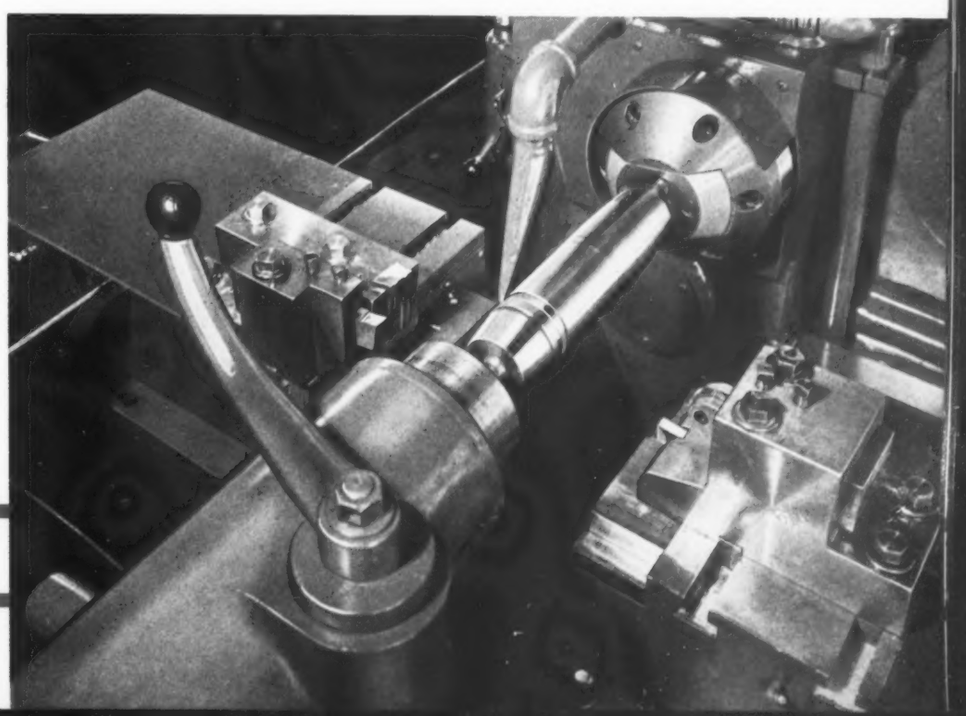


Fig. 8. Another Automatic Lathe that Finish-forms, Skives, and Knurls Rifling-band Groove, Forms the Crimping Groove, and Faces the Closed End

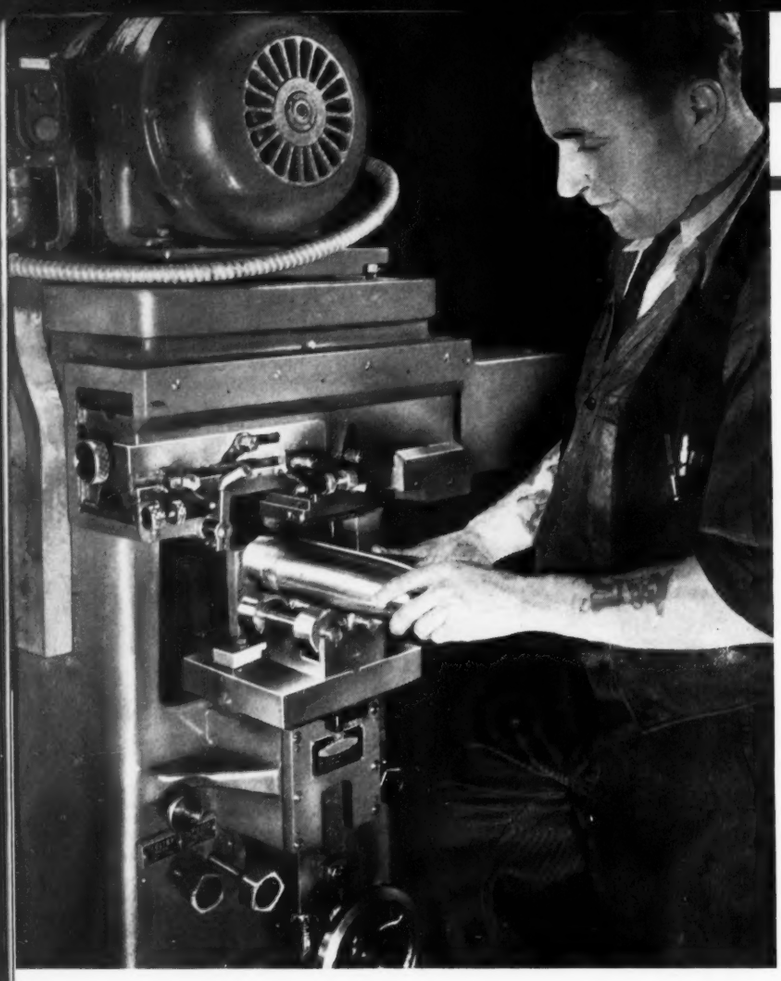


Fig. 9. Marking the Shell Size and Other Information with a Stamp that is Rolled across the Shell Periphery

end of the cavity to a definite contour and size, thus eliminating any necessity of machining the formed inside. Before the nosing operation, the hole at the open end is approximately 2 1/8 inches in diameter; at the end of the operation, this diameter is about 1 3/8 inches. The length of the nosed section is about 2 1/2 inches.

Before the nosing operation, the open end of the shell is dipped in lard oil and then rolled in a dry drawing compound that consists of 90 per cent of powdered soap and 10 per cent of graphite. The combination of lard oil and the dry drawing compound provide a lubricant that greatly facilitates the cold-forming of the nose. Next, the shell is placed vertically in a heavy sectional die ring, as shown, which closes tightly around it when the punch descends and thus prevents any expansion of the shell body as pressure is applied to the upper end of the shell. The punch is a solid cup-shaped piece, set in a heavy ring of soft metal, so as to prevent bursting with the application of heavy pressure.

Finishing Operations Performed in a Six-Spindle Automatic and Automatic Lathes

After the nosing operation, the shells are passed to the six-spindle automatic shown in Fig. 6 for the performance of a series of cuts on the open or nose end of the shell. In the first working station, at the lower front of the machine, the shell is counterbored by a tool on the central slide, and rough-faced by a cutter on the swinging arm at the front of the machine, which is actuated by a cam.

In the second working station, at the bottom of the machine, the shell is semi-finish counterbored by a tool on the central slide. In the third working station, at the lower rear of the automatic, the shell is finish-counterbored by a tool on the central slide, and finish-faced by a cutter on a lower rear arm, which is also actuated by a cross-feed cam.

A tool on the central slide in the fourth working station is fed into the shell opening to a distance of approximately 1 1/2 inches, and then moved

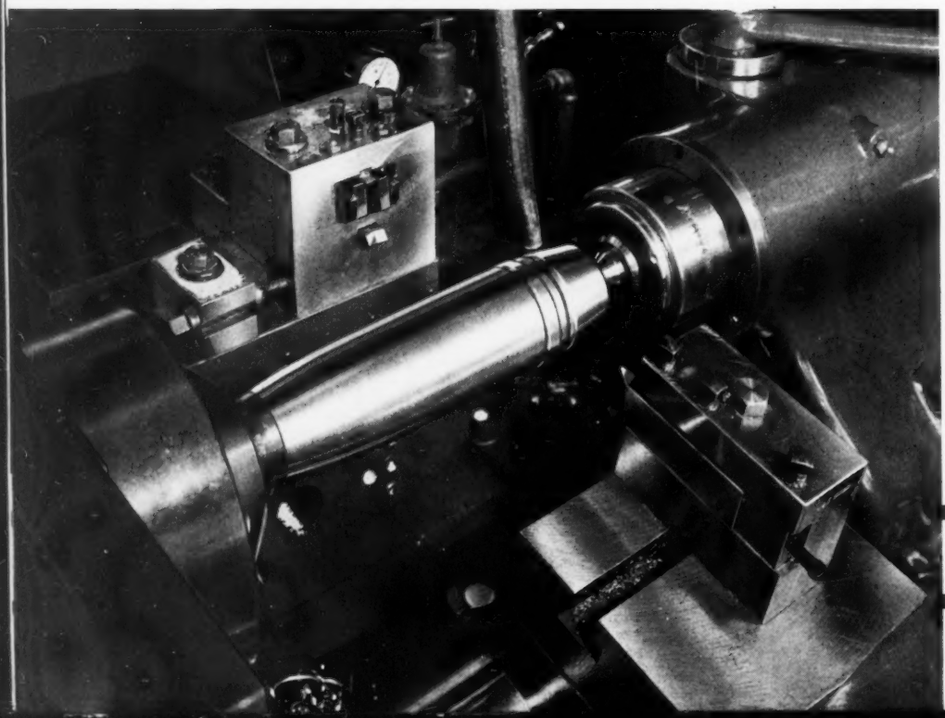


Fig. 10. Turning, Beveling, and Facing Both Ends of the Rifling Band to the Required Width in an Automatic Lathe

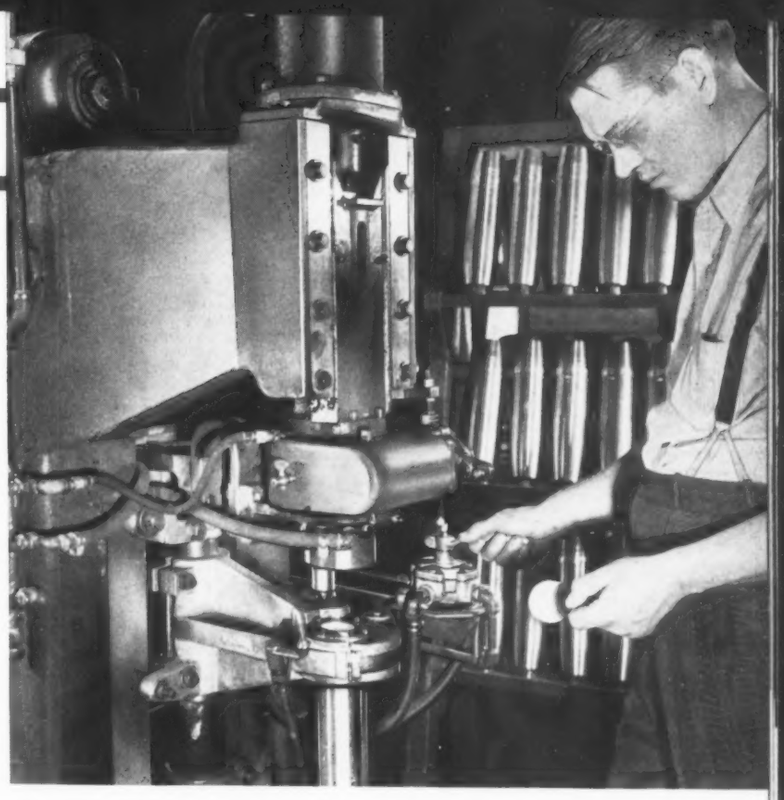


Fig. 11. Welding a Thin Disk of Steel on the Base End of the Shell to Seal it against Any Minute Cracks

sidewise for cutting a recess to provide clearance for a tap used in the next station of the machine. The recessing tool also chamfers the outer end of the hole. Finally, in the top station of the automatic, the shell is threaded internally at the nose end by the use of a collapsible tap on the central tool-slide. The threads are 2 inches in outside diameter, and twelve per inch.

The shells next go to the finish-turning automatic lathe, shown in Fig. 7. Before this operation, however, a threaded plug or adapter is screwed into the tapped opening of the shell. The adapter is center-drilled on the side opposite its threaded shank to provide a means for supporting the nose end of the shell on the headstock center of the machine, while the other end is supported by the tailstock center. This makes it possible to finish-turn the shell in close concentricity with the forged shell interior. The concentricity must be within 0.015 inch at all points.

Finish-turning of the shell is performed by three tools on the front carriage of the automatic lathe. The tool seen in the foreground is pulled radially outward as it feeds along the work, so as to turn a taper above the base end of the shell, and then it moves in a straight path for cylindrical turning. The next tool remains in one position on the carriage, because it turns a straight cylindrical surface only. The third tool moves parallel with the shell center line for a short distance for cylindrical turning, and then is fed radially toward the center of the machine to finish the tapered shell nose.

The in and out movements of the first and third tools are obtained through the use of a profile or cam bar. This bar is mounted on the tool-slide, but is held in a stationary position, as it is attached to the tailstock of the machine, while the tool-block moves longitudinally with the carriage. Rollers attached to the tool-holders follow the changing contour of the cam bar and impart corresponding in and out movements to the tools. Helical springs hold the rollers firmly against the cam bar.

While the turning cuts are in progress, two tools at the rear of the machine slide forward under the control of a circular cam to face the base end of the shell and start forming a rifling-band groove. Excellent production has been obtained by the use of tungsten-carbide tools. The work runs at 400 R.P.M., and about 3/32 inch of stock on the diameter is removed at a feed of 0.020 inch.

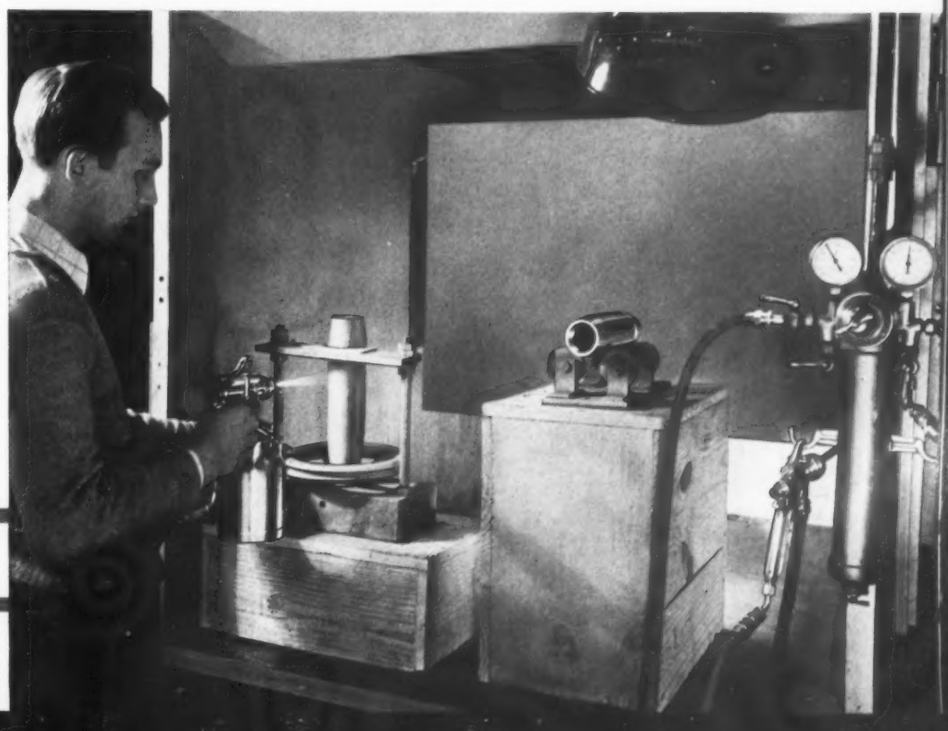


Fig. 12. Booth in which Shells are Sprayed with an Acid-proof Paint on the Inside and a Lacquer on the Outside

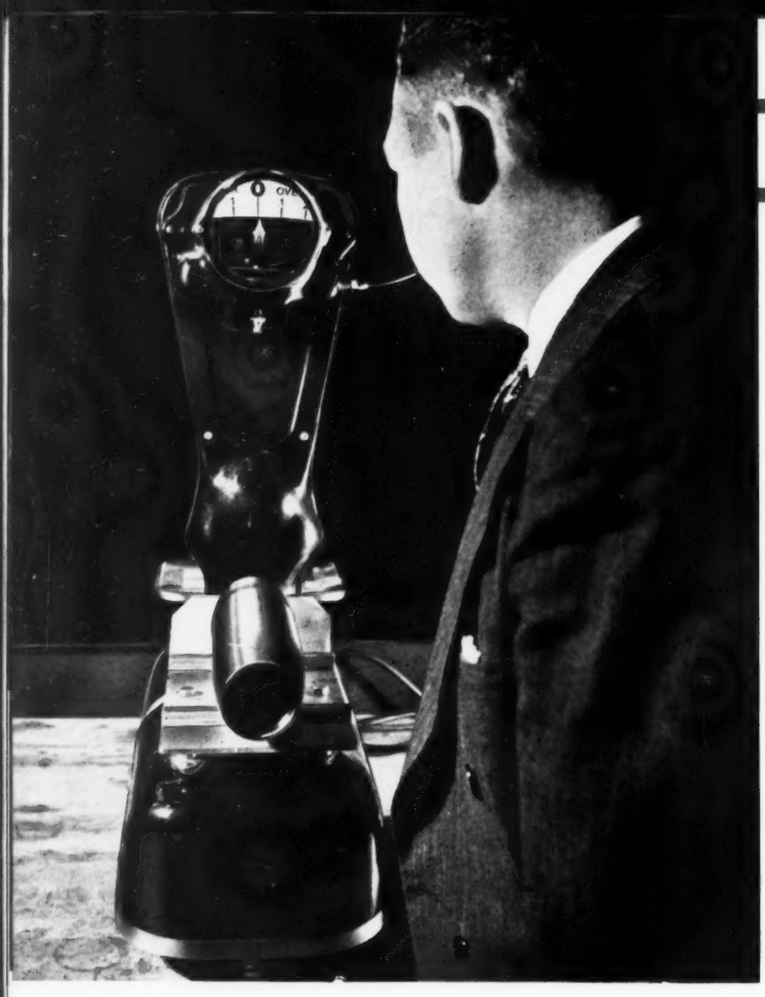


Fig. 13. Every Shell Must be of the Specified Weight within a Limit of 0.3 Pound, as Determined by the Scale Seen in This Illustration

The rifling-band groove and a narrow groove adjacent to it, which is used in crimping on the cartridge case, are next finish-formed by tools on the front slide of the automatic lathe illustrated in Fig. 8; the front slide is seen at the left of the illustration. A second tool on this slide faces the base end of the shell. Both tools are fed straight in for the operation. At the end of the front-slide movement, two tools at the rear slide, on the right, are brought into action. One of these tools, which is ground for forming four annular threads in the rifling-band groove, is fed tangentially to the bottom of the shell in the manner of a skiving tool. Above the skiving tool, positioned centrally in relation to the work, is a circular knurling tool for pressing grooves at close intervals across the annular threads.

In loading this machine, the tailstock center is brought against the base end of the shell by hand. Then, as the rear tool-slide starts advancing in synchronism with the front slide at the beginning of an operation, a valve is tripped to admit air to a cylinder within the tailstock in back of the quill that holds the center. With this arrangement, the tailstock center is held firmly against the work by air pressure during the operation. When the rear tool-slide recedes to its starting position, the valve is tripped to release the air pressure and permit the tailstock center to be withdrawn by hand. Both the front and the rear tool-slides are actuated hydraulically. All the cutters used in this operation, with the exception of the knurling tool, are tungsten-carbide tipped.

A copper rifling band is next squeezed tightly around the knurled groove by the application of a conventional type of machine equipped with six jaws that are advanced radially under heavy pressure against the copper band. The rifling band is then machined in an automatic lathe tooled up as shown in Fig. 10. A tool on the front carriage turns the band as the carriage is fed longitudinally,

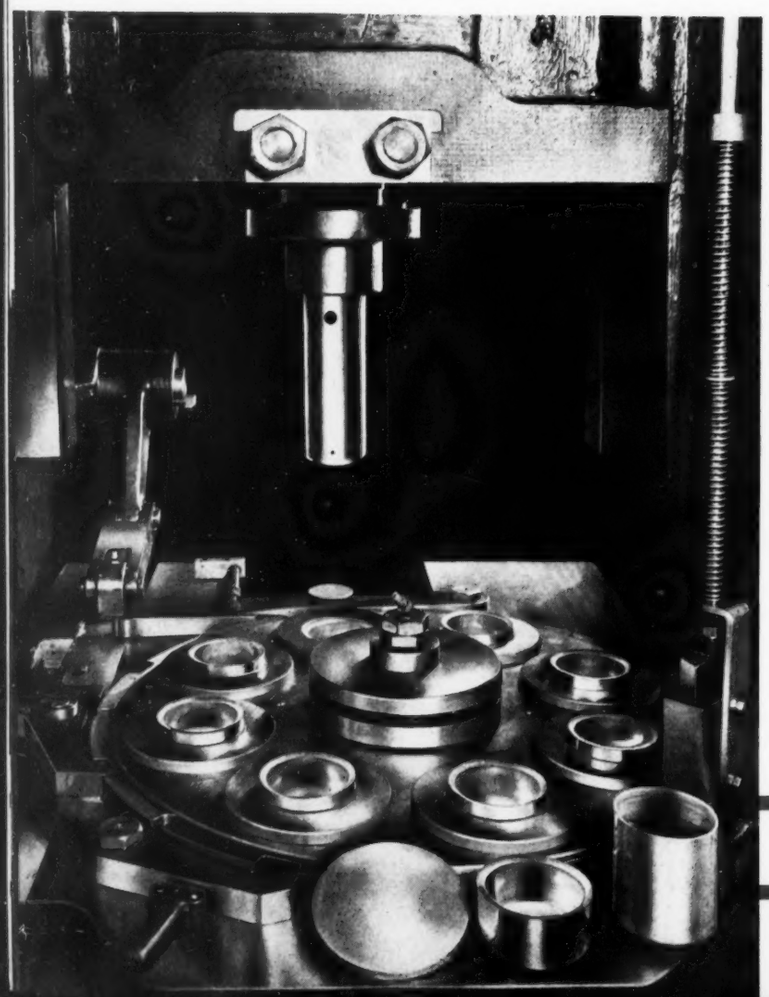


Fig. 14. Press with Indexing Feed Dial, Employed in Cupping and First Drawing Operations on Cartridge Cases

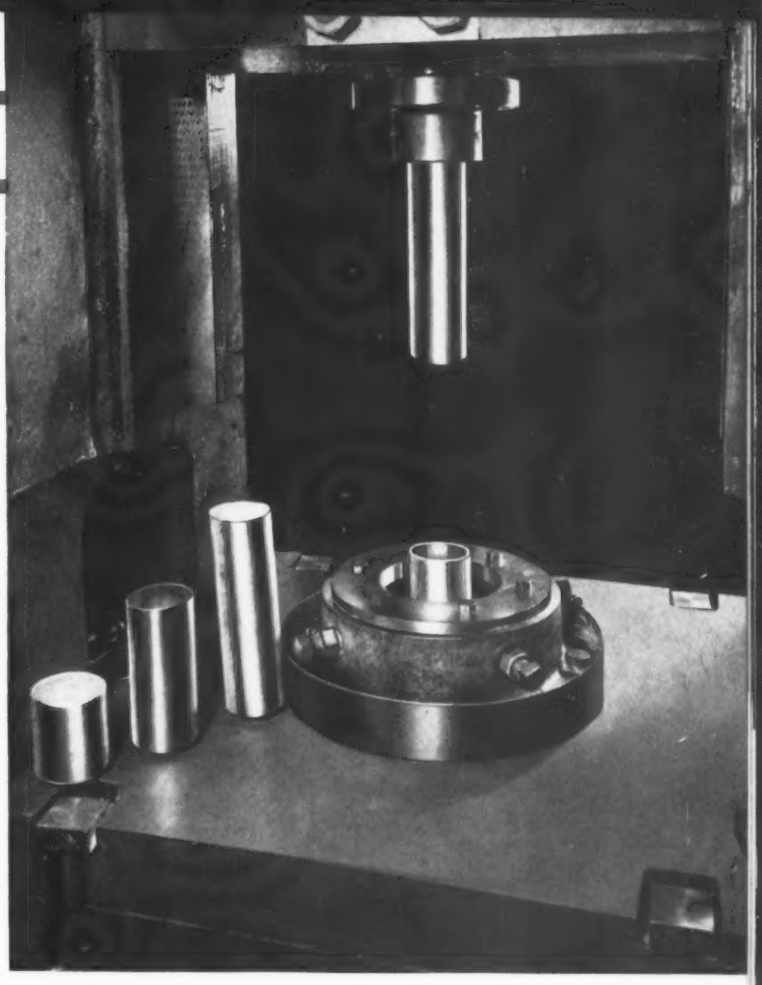


Fig. 15. Punch and Die Equipment Employed for One of the Operations Performed on a Press that is Used for the Second and Third Draws

the tool being advanced to depth by the automatic lifting of a guide bar beneath the carriage. At the same time, tools on the rear slide are advanced for beveling the sides of the rifling band and facing it on both edges to the required width. The beveling cuts are taken by the two lower tools seen on the rear slide, one of which cuts a bevel to a width of about 1/8 inch, while the other merely relieves a sharp corner.

The two cutters that face the rifling band to width are seen directly above the beveling cutters, mounted in a spring-backed block. The inner side of each cutter is seated against a spacer block, and the outer side against a narrow stop-bar which projects beyond the cutters and rides against the shell during the time that these cutters are in operation. This arrangement insures clean cuts without burrs.

After several minor operations, such as spot-facing the boss from the base end, the shells are passed to the marking machine shown in Fig. 9, in which a steel stamp is slid over the periphery of the shell as the latter rotates with the stamp. The stamp marks the size, lot number, identification symbols, etc., on the shell. To facilitate rotation, the shell is placed on four ball-bearing rollers. The stamp slide is actuated hydraulically.

The next operation consists of welding a disk of mild steel, 1/32 inch thick, on the base end of the shell. The purpose of this disk is to seal any minute cracks which might admit gases to the explosive on the inside of the shell developed from the explosive in the cartridge case when a gun is fired. The welding operation is performed by the machine illustrated in Fig. 11, with the shell placed upright in a beveled locating ring provided for the nose end. The upper end of the shell is held in the proper location by a current-conducting bracket constructed with a swinging arm, which is clamped on the shell after it has been positioned. Operation of the swinging member is obtained through

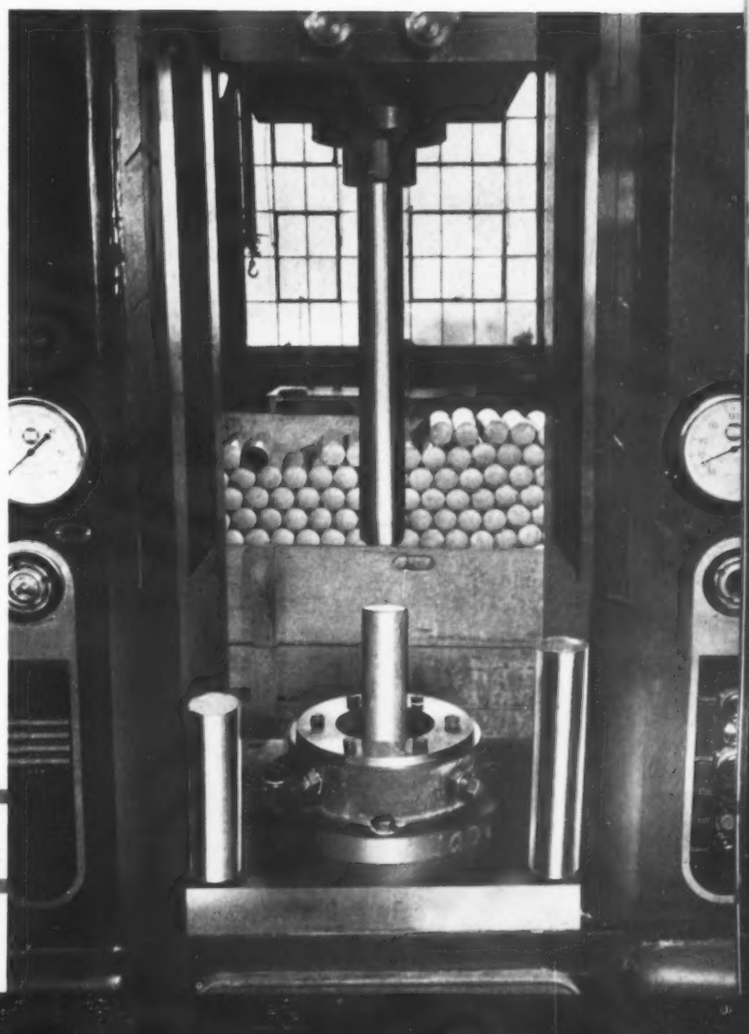


Fig. 16. Hydraulically Operated Press Set up for Performing the Fourth Drawing Operation on Cartridge Cases

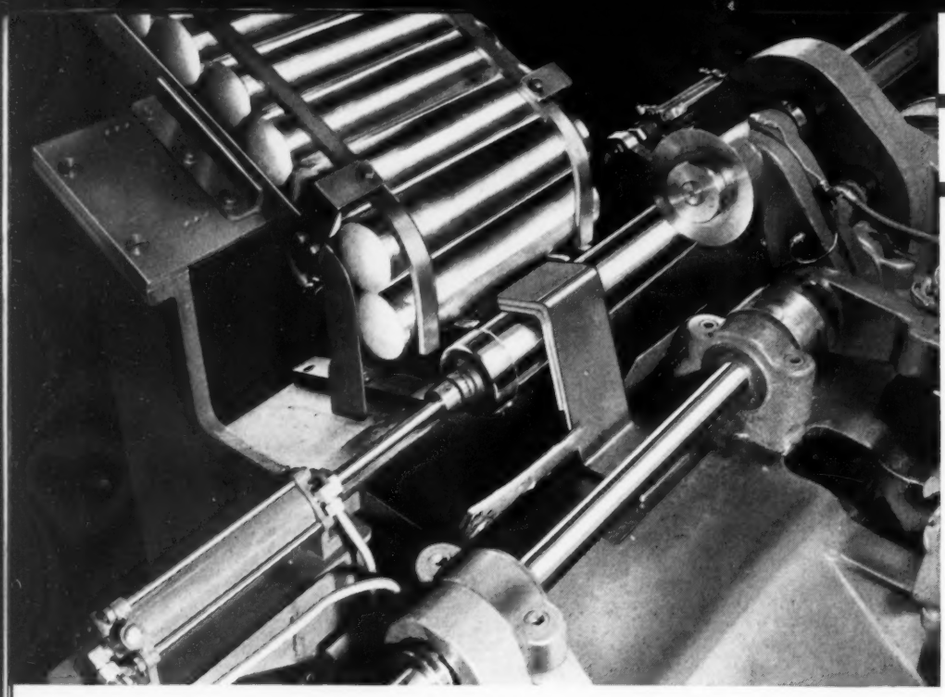


Fig. 17. An Automatic Machine Designed for Trimming the Open End of the Cartridge Cases at a Rapid Rate

air pressure. This bracket serves the purpose of a lower electrode.

With the shell clamped as shown, a foot-pedal is depressed, causing the upper electrode ram to travel up and down at a fast rate. At each return stroke of the ram, the upper electrode is indexed a slight amount, so that successive spot-welds are made close enough together to obtain a practically continuous weld. About thirty-two spot-welds are made around the disk. The machine stops automatically when the operator removes his foot from the pedal. The beveled ring in which the shell is laced can be adjusted vertically to suit the length of the shell by turning the crank-handle seen extending upward along the left-hand side of the fixture.

After the spot-welding operation, the shells are thoroughly washed and then passed to the spray booth shown in Fig. 12, where a black acid-proof paint is sprayed into the interior and a yellow lacquer on the outside. Before painting the interior, the shell is laid on the roller stand seen at the right, and a spray gun is employed, which is equipped with a long nozzle that can be inserted in the shell. The exterior is sprayed with the shell placed vertically on the stand at the left, which can be revolved by hand.

Between the washing and spraying operations, the shell is completely inspected for dimensions and visible defects. After being painted, it is weighed on the scale illustrated in Fig. 13, which is graduated to show an error of 0.1 pound by lines spaced about 3/8 inch apart. The specified weight of the shell, 10.7 pounds, must be attained within plus or minus 0.3 pound.

Besides the dimensional and weight inspections, a strength test is performed periodically under a 75-ton hydraulic press. In this test, the shells must not burst when subjected to a load of 25,000 pounds, applied in the vertical direction. Any possible cracks or pipes in a shell are detected in a test that is performed immediately after the final machining operation. For this test, the shell is

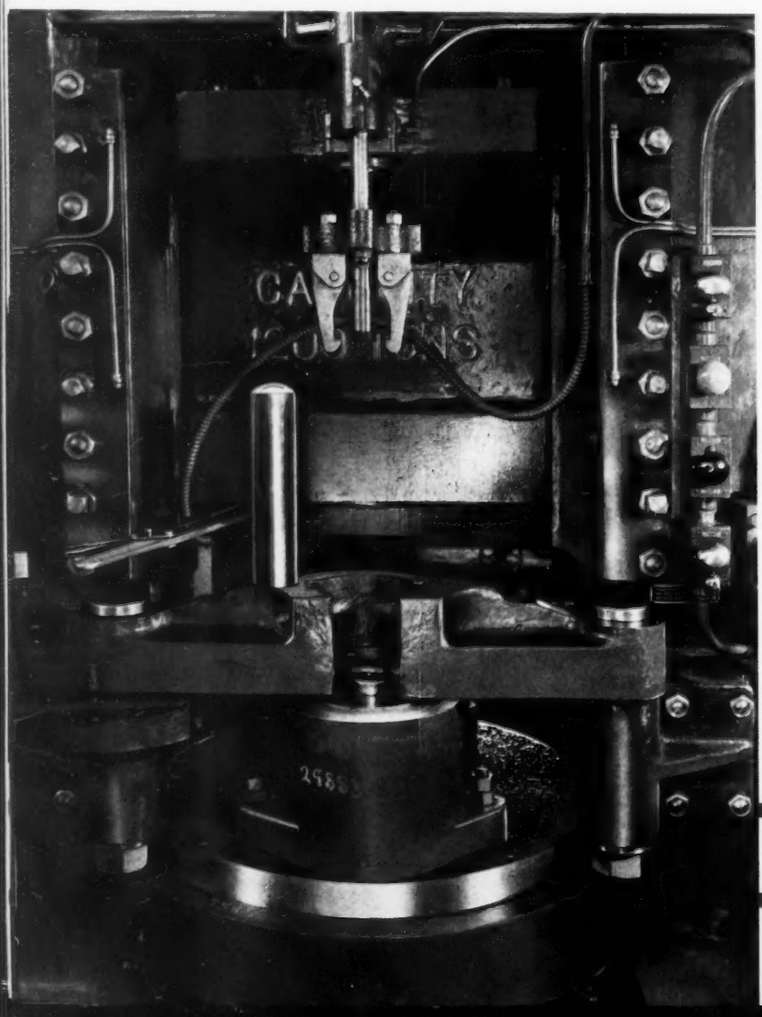


Fig. 18. Close-up View of the Press that Heads Closed End of Cartridge Cases. An Indexing Die Permits Reloading while Heading is in Process

placed upright in a tank of water, and air at a pressure of 200 pounds per square inch is admitted to the sealed inside of the shell. The presence of defects in the shell metal is indicated by air bubbles rising to the surface of the water. This test is performed on all shells.

Press Operations Performed in Manufacturing Cartridge Cases

Cartridge cases are produced by more or less conventional methods in that the manufacture starts with a disk of brass, which is formed into a cup and then gradually drawn to the required diameter and length. With the present educational order set-up, some of the presses are used for two operations, the punches and dies being changed to suit after a lot of cartridge cases has been run through one operation.

The press used for the cupping and first drawing operations is shown in Fig. 14, the first drawing operation being illustrated. This press is equipped with a dial feed to insure complete safety of the operator and to expedite the operation. The dial is loaded at the front of the machine and indexed counter-clockwise to bring the successive pieces of work beneath the punch. The eight-station dial is indexed automatically at each return stroke of the press ram by means of the lever arrangement seen at the left. Two locking members, one of which is connected to a snap-lock switch, must engage slots in the feed dial before the press ram can make a down stroke.

A drawing compound developed especially for use in deep drawing operations is employed, the disks and cups being dipped completely into the compound. The same punch is used for both the cupping and first drawing operations, but the adapters in the feed dial must be changed. The cartridge cases are pushed completely through the dies and roll down a chute to a receptacle at the back of the machine.

The brass disks from which the cartridge cases are cupped are 5.40 inches in diameter within plus 0.01 inch, minus nothing, and 0.44 inch thick within plus 0.01 inch, minus nothing. They are cupped to a diameter of approximately 3 1/4 inches and to an internal depth of 1 7/8 inches, and are drawn to a depth of approximately 3 5/8 inches inside in the first drawing operation. Between the cupping and first drawing, as well as after each following draw, the cartridge cases are annealed, and then pickled and washed. These steps will be described in detail later.

The press employed for the second and third drawing operations is illustrated in Fig. 15. At the left of the die are seen cartridge cases as they appear following the first, second, and third draws. As in the cupping and first drawing operations, the cartridge cases are pushed down through the die in the second and third draws. In the second draw, the inside diameter of the cartridge case is decreased slightly, and the internal length is increased to approximately 6 5/8 inches, there being, of course, a corresponding reduction in the thickness of the wall. In the third draw, the inside diameter is decreased to approximately 3 3/16 inches and the inside length is increased to 10 15/16 inches.

The hydraulically actuated press shown in Fig. 16 is employed for the fourth drawing operation, in which the shell is drawn to a length inside of between 14 1/8 and 14 1/2 inches, the inside diame-

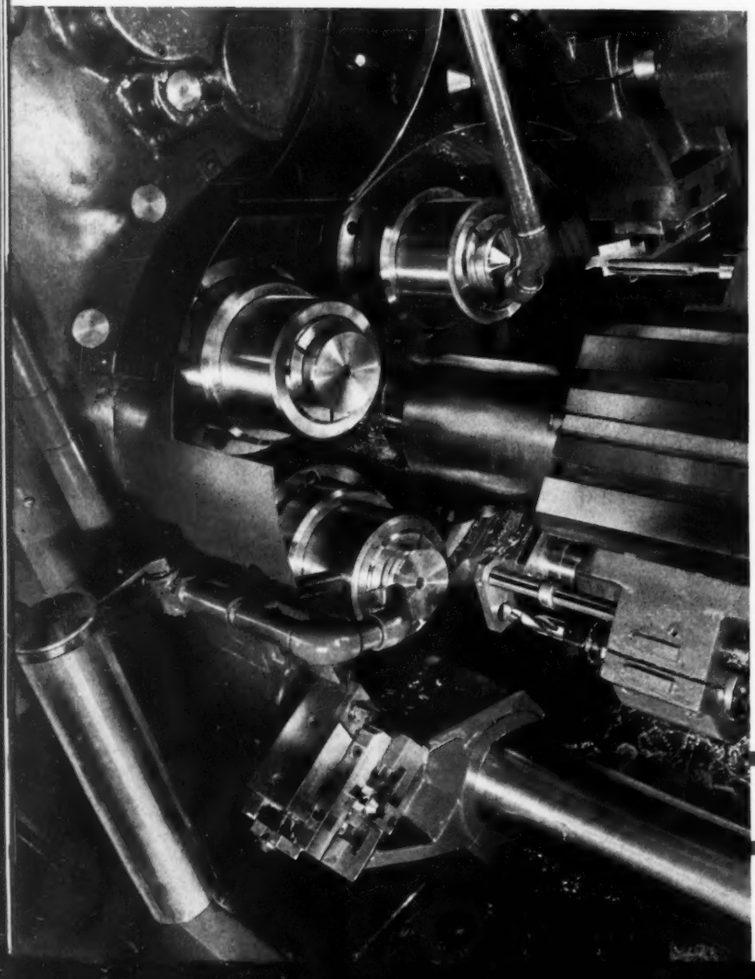
Fig. 19. Lowering a Rack of Cartridge Cases over the Air Pipes that Project above a Bath of Liquid Saltpetre Used for Low Annealing

ter remaining approximately the same as after the third draw, but the thickness of the shell being still further reduced. Again, the cartridge case is pushed through the die.

When the cartridge cases leave this press, they are transferred to the trimming machine illustrated in Fig. 17, which is equipped with a magazine for automatically feeding the cases to the working position. A cam-operated slide at the bottom of the magazine pushes successive cartridge cases forward into line with an arbor attached to the headstock spindle. Then an air-operated ram on the left-hand end of the machine, as viewed in the illustration, advances to push the open end of the cartridge case on the headstock arbor.

A circular cutter, 6 inches in diameter, with the edge ground to about 45 degrees, next swings down on the cartridge case for trimming the open end to length. The arbor is fitted with a floating ring opposite the cutter. With the application of cutting pressure, this floating ring slides sidewise a limited amount, so as to permit the cutter to shear readily through the metal. At the end of each operation, an air-operated rod in the center of the arbor and headstock spindle pushes the cartridge case from the arbor, and it rolls into the bed of the machine.

Fig. 20. Four-spindle Automatic Tooled up for Machining the Primer Hole, and Turning and Facing the Headed End of Cartridge Cases



Annealing the Cartridge Cases in Gas-Fired Furnace and Liquid Saltpetre Baths

Five annealing operations are performed on the cartridge cases between the various press operations. They are conducted in a large pusher type gas-fired furnace, operated at a temperature of 1120 degrees F. During the first three annealing operations, the cartridge cases remain in the furnace for one hour fifteen minutes, and during the remaining two anneals, for one hour. When the cases are discharged from the furnace, they are immediately lowered into a pickling tank to remove all scale, and are then successively immersed in cold rinsing, washing, and hot rinsing tanks.

After the trimming operation, the cartridge cases are headed on the closed end by a 1200-ton press equipped as illustrated in Fig. 18. The indexing fixture is provided with two dies, so as to permit the performance of a heading operation on one cartridge case while a previously headed case is being removed. Little time is, therefore, lost in reloading.

A mechanical knock-out device raises the headed cartridge case slightly when the die is indexed to the front of the press. Then an air-operated pick-up, seen near the top of the illustration, lowers two fingers, which slip under the flanged head of the cartridge case. The cartridge case is pulled completely out of the die by these fingers with the upward movement of the device. Careful attention to all drawing operations, with a view to insuring that there will be sufficient material in the closed end of the cases when they reach the heading operation, is of utmost importance to successful cartridge-case manufacture.

Upon the completion of the heading operation, the cartridge cases are annealed for a length of 9 1/2 inches from the open end to prepare them for a tapering operation. This annealing is performed in a bath of liquid saltpetre, maintained at a temperature of 950 degrees F. The cases remain in the bath for one and three-fourths minutes. Quantities of thirty-five cases are handled at a time, the cases being loaded on racks, as shown in Fig. 19, and lowered over pipes that extend above

the liquid saltpetre. These pipes are all connected to one another at the bottom, and also to a vent pipe which projects above the bath, as seen at the left. With this arrangement, air that would otherwise be trapped in the cartridge cases when they are lowered into the bath, and would cause them to float, passes out through the vent pipe.

When the cases are taken from the annealing bath, they are immediately lowered into a tank fitted with a large number of vertical pipes which spray water all over them and cause almost instant cooling. The cartridge cases are then pickled, washed, and rinsed again. An air hoist facilitates all these operations. The bath is gas-heated.

A tapering operation is next performed on the open end of the cartridge cases by the hydraulic press that is used for the fourth draw. A different punch and die are, of course, employed. After the tapering operation, the cartridge cases are subjected to another low anneal, performed in a second bath of liquid saltpetre, for annealing a length of about 2 1/2 inches from the open end. This bath is maintained at a temperature of 950 degrees F., and the cases are submerged for one and three-fourths minutes.

Machining the Headed End of the Cartridge Cases

The next operation on the cases consists of machining the headed end in the four-spindle automatic shown in Fig. 20. In the loading station, seen at the top front of the machine, the cases are slipped into collets of the spindle carrier. In the first working station, at the bottom front of the machine, a combination drill and counterbore on the central tool-slide advances to rough-machine the primer hole. At the same time, the tool-arm at the front of the machine rocks in to rough-turn and rough-face the head of the cartridge case.

In the second working station, at the lower rear of the machine, a combination taper reamer and counterbore on the central slide perform a second operation on the primer hole. At the same time, a tool-arm at the rear of the machine rocks in to finish-turn the head. In the third working station, at the upper rear of the machine, a combination tool on the central slide finish taper-reams and counterbores the primer hole. The end of the shell is finish-faced by a tool on an upper arm which rocks in for taking the cut. Tungsten-carbide cutters are used for the turning and facing cuts.

The open end of the cartridge case is next accurately finished to length under a sensitive drilling machine equipped with a piloted tool of special design. Two cutters face the end of the shell, and two others round the edge. The cartridge cases are then annealed once more at a temperature of 500 degrees in a gas-heated furnace, in which they remain for one hour. As many as 480 cases may be loaded in a basket at one time for this operation.

The cartridge cases are next completely inspected for dimensions, contour, and visible defects, after which they go to the marking machine shown in Fig. 21, which is equipped with a stamp for marking the size, the lot number, and other symbols on the headed end of the cases. To facilitate this operation, the cartridge cases are placed upright, one at a time, on a post attached to a swinging arm. This post is swung into line with the cylindrical stamp for the marking operation, and the marking is accomplished as a horizontal ram rolls the stamp across the cartridge case from right to left. The marks are made in a circle around the headed end.

Fig. 21. Information is Marked in a Circle around the Headed End of Cartridge Cases by Moving a Cylindrical Stamp across the Work

Machine Guns-

Photo by U. S. Army Signal Corps

THE engineering and production facilities of the General Motors Corporation are being extensively applied toward the mass production of an impressive variety of wartime equipment required under the National Defense Program. In the field of aviation, the corporation has contracted to build Allison liquid-cooled engines, Pratt & Whitney radial air-cooled engines, and parts and sub-assemblies for twin engine bombing planes. In addition, one of its plants is engaged in filling an order for $7,000,000 worth of airplane control mechanisms and instruments.

Four plants are being erected and rapidly nearing completion for the manufacture of machine guns by mass production methods. Another plant especially set up for the purpose is already engaged on a large shell order. Diesel engines are being supplied in important numbers for propelling submarines and other vessels of the United States Navy. Trucks designed for military use are also running off assembly lines by the thousands. The defense orders received by the General Motors Corporation up to February 1 have an approximate value of appreciably more than half a billion dollars.

One of these National Defense activities which differs entirely from that of any other automotive concern is the manufacture of machine guns. Preparatory to equipping four large plants for machine gun manufacture, one small plant was set up at the Saginaw Steering Gear Division to fill an educational gun order. This educational order has served as a basis for the development of methods that will be applied in mass production in other plants of the General Motors Corporation. Typical methods developed in the educational order plant are described in this article. Air-cooled 0.30-caliber

One of General Motors Defense Activities

machine guns are made in this plant, which is working on an order for 500 guns and 3000 barrels.

The new plant erected adjacent to this educational order plant will probably be in operation when this article goes to print. The building is 660 feet long by 361 feet wide. As in other gun plants, the operations that differ materially from the ones performed in ordinary machine shops are those involved in manufacturing the gun barrels. These operations will be described first.

The gun barrels are produced from bar stock of S A E 4150 steel, which is cut up to lengths of approximately 24 1/8 inches on a Racine hydraulic hacksawing machine. The bars are heat-treated to a hardness of 300 Brinell before any machining is performed. The first machining operation consists of milling the bars to length within close limits in the Davis & Thompson drum type continuous milling machine shown in Fig. 1. The bars of stock are loaded on the revolving drum at the top, which carries them down around the back of the machine past rough-milling cutters that operate on the opposite ends. The bars then continue moving up past finishing cutters at the front of the machine that mill the opposite ends. Link chains hold the pieces in place as they move around the machine.

One of the finishing cutters may be seen in the illustration. The roughing cutters remove from 1/32 to 1/16 inch of stock from the bar ends, while the finishing cutters merely clean up the ends. The milling cutters are of the inserted-blade type, and are 6 inches in diameter.

The next operation on the machine gun barrels consists of center-drilling both ends in the Lo-Swing double-end machine shown in Fig. 3. For this operation, the gun barrel is accurately located in the V-block of a rest seen at the left, and also on a plug and between narrow angular blades of the right-hand rest. Each rest is equipped with a hand-operated clamp. Both ends of the barrel are drilled simultaneously as the two spindle heads advance toward each other. The same machine is employed for recentering the gun barrels after they have been rough-turned and drilled their full length. The illustration shows a recentering operation, in which floating holders are provided for the center drills so that they are free to follow the drilled bore.

A width of approximately 1 1/4 inches is next ground in the middle of the barrel stock to provide a finished surface for a roller rest employed in rough-turning the stock. This grinding operation is performed on a machine of the standard cylindrical type. The barrels are next rough-turned in a Lo-Swing automatic lathe equipped, as shown in Fig. 2, with four cutters on the front carriage and one cutter on the rear slide. Three of the cutters on the front carriage machine a cylindrical surface, each cutter being moved longitudinally a distance of 3 inches. The fourth cutter, which appears in the left foreground, cuts cylindrical surfaces to two diameters. This is accomplished by the cutter being pulled toward the front of the carriage as a roller on one end of the quill which holds the tool rides along a stationary cam bar during the feed of the carriage along the bed. While the cutters on the front carriage are in action, the cutter on the rear slide advances to chamfer the barrel.

When one half of a barrel has been turned, the barrel is reversed in the machine and the opposite end turned. All tools are tipped with tungsten carbide. The barrel is supported near the center by a roller rest. After being rough-turned, the barrels are finish-turned in a similar automatic lathe.

Drilling of the barrels is next performed in a Pratt & Whitney gun drilling machine of the conventional design shown in Fig. 5, which drills two barrels at one time. Single-flute drills in heads attached to carriages seen at the left are fed through the barrels at the rate of 1 1/4 inches a minute. During the operation, oil at a pressure of between 500 and 600 pounds per square inch is forced through a hole that extends through the center of each drill stem to the cutting edge so as to wash out all chips from the gun bore along a flute in the drill stem. The barrels are drilled to a diameter of 0.289 inch within a tolerance of 0.0005 inch, and

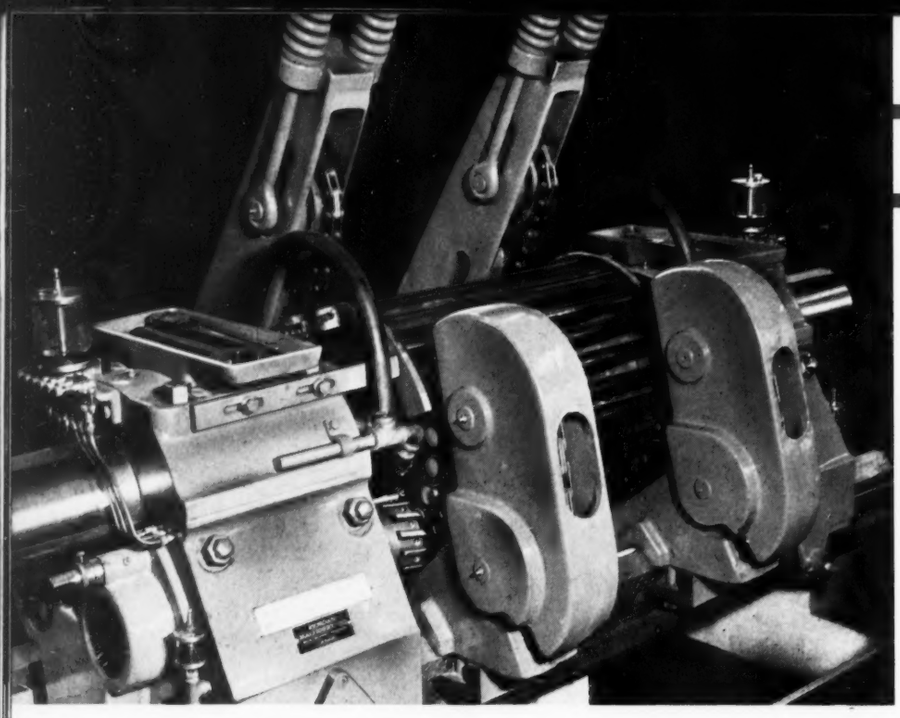


Fig. 1. Drum Type Continuous Milling Machine which Finishes the Ends of the Gun Barrel Stock to Length

with not more than 0.004 inch runout from one end of the 24-inch long barrel to the other.

Upon the completion of the drilling operation, the gun barrels are recentered, as already described, in the machine shown in Fig. 3. They are then finish-ground externally on the cylindrical grinding machine shown in Fig. 4 within a total tolerance of 0.001 inch. A wheel 2 inches wide is employed.

Reaming cuts are then taken in the barrel bores in a Pratt & Whitney machine somewhat similar in design to the drilling machine shown in Fig. 5. In the reaming operations, however, the barrels are mounted on a carriage and are pulled along the reamers, the stem of the reamers being slipped through the drilled hole in the barrels and attached to the headstocks, while the work carriages are fed away from the headstocks. In the drilling operation, on the other hand, the gun barrels remain in one position and the drill heads are fed to them.

Four-flute reamers are employed, and oil under heavy pressure is fed through a hole in the center of the reamers to the cutting end for washing all chips from the bore. Five reaming cuts are taken, two roughing and three finishing. The last reamer removes stock to a maximum depth of 0.0005 inch. The reaming cuts are taken at a feed of 5 inches a minute. Floating chucks are used to permit the reamers to follow the drilled bores.

After being reamed, the barrels are passed to Hanson-Whitney thread milling machines, set up as shown in Fig. 7, for machining threads on the breech end. The gun barrels are held accurately for this operation in a long chuck into which they are loaded from the left-hand end of the headstock. They are gripped in a collet chuck at the front end of the headstock and located in a bushing near the rear end. The thread is milled in one revolution of the barrel.

The lead of the thread is controlled by means of a cam in the base of the machine, and must be true within 0.0004 inch. The tolerance on the pitch diameter of 15/16 inch is 0.0036 inch. Wooden trays and tables are provided on practically all the machines used in barrel operations, so as to guard against damage to the work.

The barrels go next to the Ex-Cell-O rifling ma-

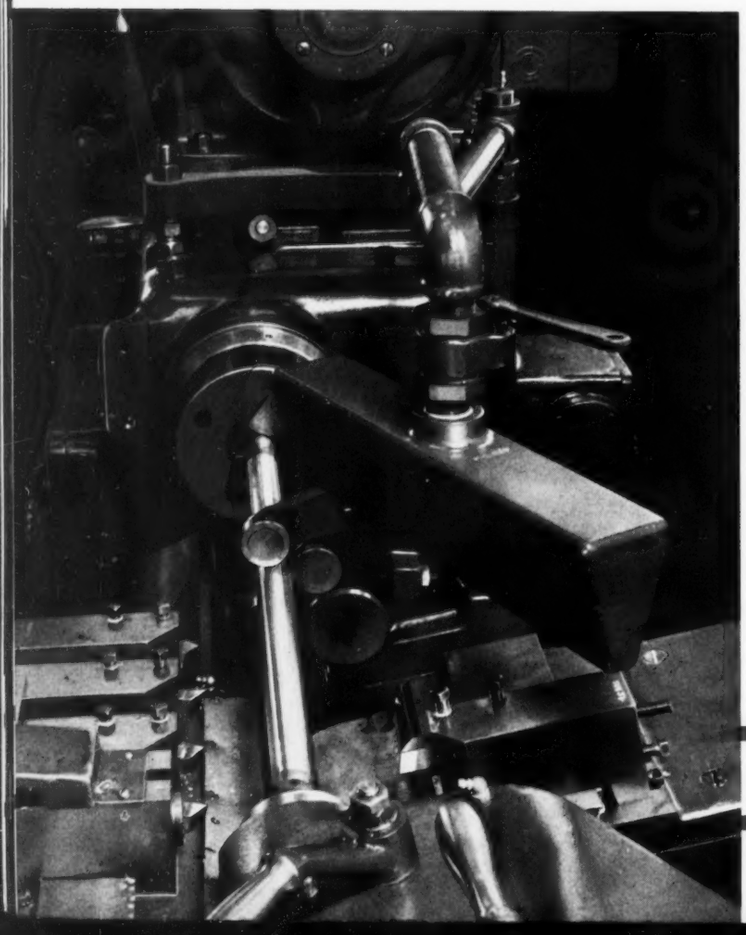


Fig. 2. Tooling Equipment Provided on an Automatic Lathe for Rough-turning the Machine Gun Barrels

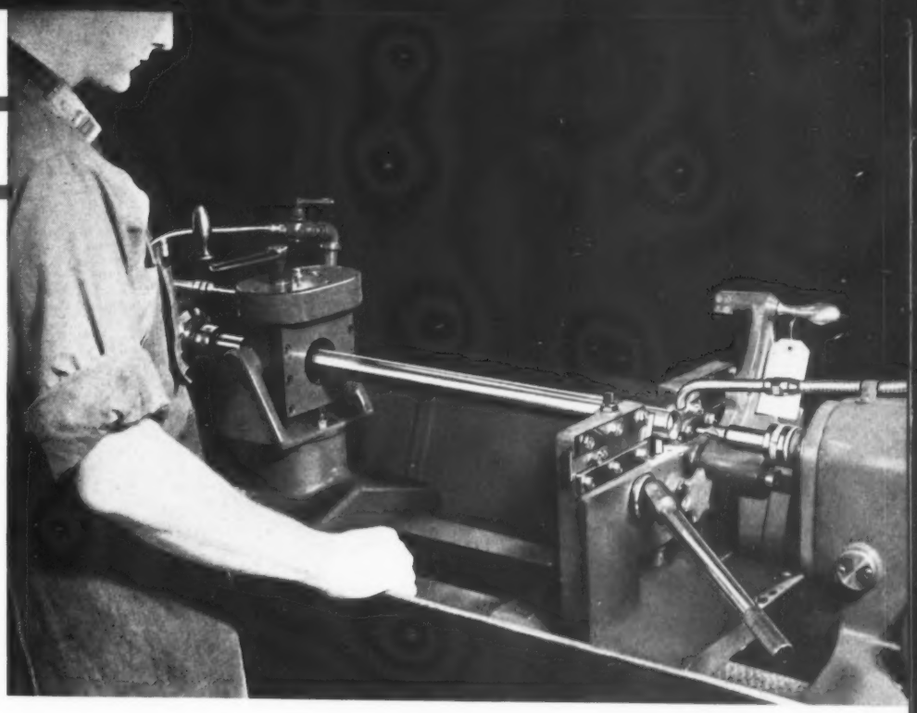


Fig. 3. Double-end Machine Used for Centering the Barrels, Ready for Turning and Recentering Them after Drilling

chine shown in Fig. 6 for cutting four grooves the full length of the barrels at a lead of one turn in 10 inches. Prior to loading the barrels in this machine, which handles two barrels at a time, an adapter is screwed on the threads milled on the breech end in the preceding operation. The rifling tool is a new type of hook cutter made from high-grade tool steel and carefully honed and lapped. It is adjusted to remove stock to a depth of 0.0001 inch with each stroke through the barrel. The stem or shank which carries the cutter is slipped through the barrel bore and connected to a carriage seen at the right, which pulls the rifling tool through the barrel. During this stroke, the rifling bar is swiveled to obtain the required helix of the grooves as rollers on a stationary head mounted on the bed of the machine ride along grooves in a lead-screw to which one end of the rifling bar is attached.

Each time the grooving cutter reaches the end of its cutting stroke, a finger depresses it sufficiently so that it will not ride on the rifling groove just machined during its return stroke. Upon the completion of each return stroke, the gun barrel is indexed through 90 degrees, and the cutting tool then repeats its cycle. After every four indexings, the cutter is automatically fed upward 0.0001 inch, ready for taking the next sequence of cuts. About one hundred strokes of the rifling head are required to complete the rifling of a barrel.

The operations on the two sides of the machine are performed independently of each other. The rifling bars are operated hydraulically. Oil is fed through the rifling bars to the cutters, as in the drilling and reaming operations, to wash out the chips. Circular wire brushes mounted on stationary members of the machine revolve in contact with the rifling bars to the right of the gun barrels, so as to wipe off all chips that might mar the rifling grooves during the return stroke of the cutters.

Chambering operations performed on a Pratt & Whitney machine tooled up as shown in Fig. 8 follow rifling. One end of the barrel is inserted in a chuck seen at the right, while the other end is simply supported on brass plugs in a steadyrest, arranged in the form of a vee. A bushing is screwed on the breech end of the gun barrel prior to this

Fig. 4. The Barrels are Ground their Full Length in an Operation that Follows Drilling and Recentering

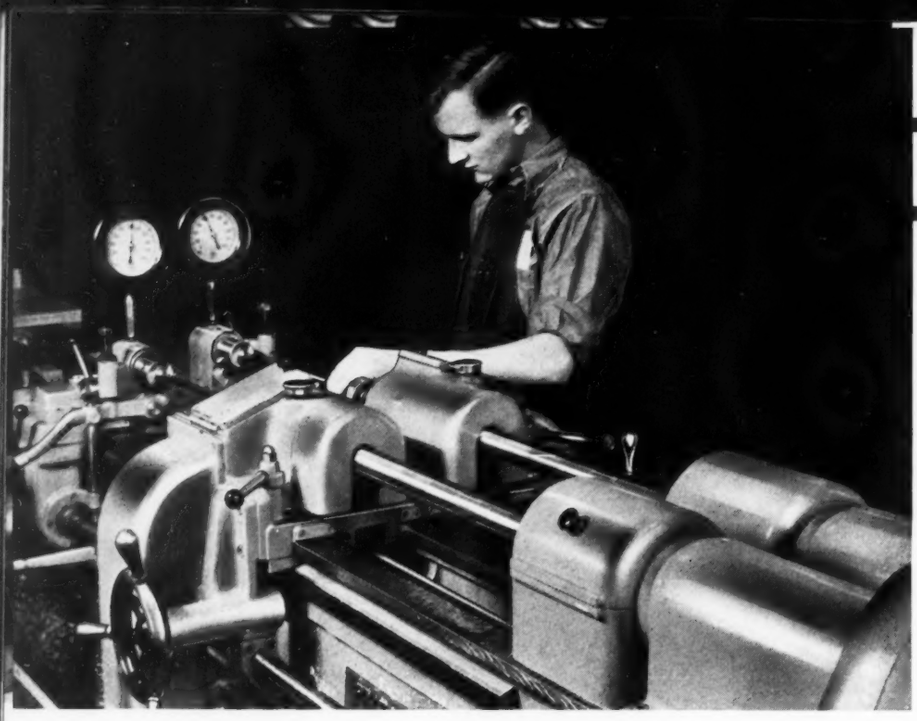


Fig. 5. Two Gun Barrels are Drilled at a Time on a Machine that Feeds Single-flute Drills through the Barrels at 1 1/4 Inches a Minute

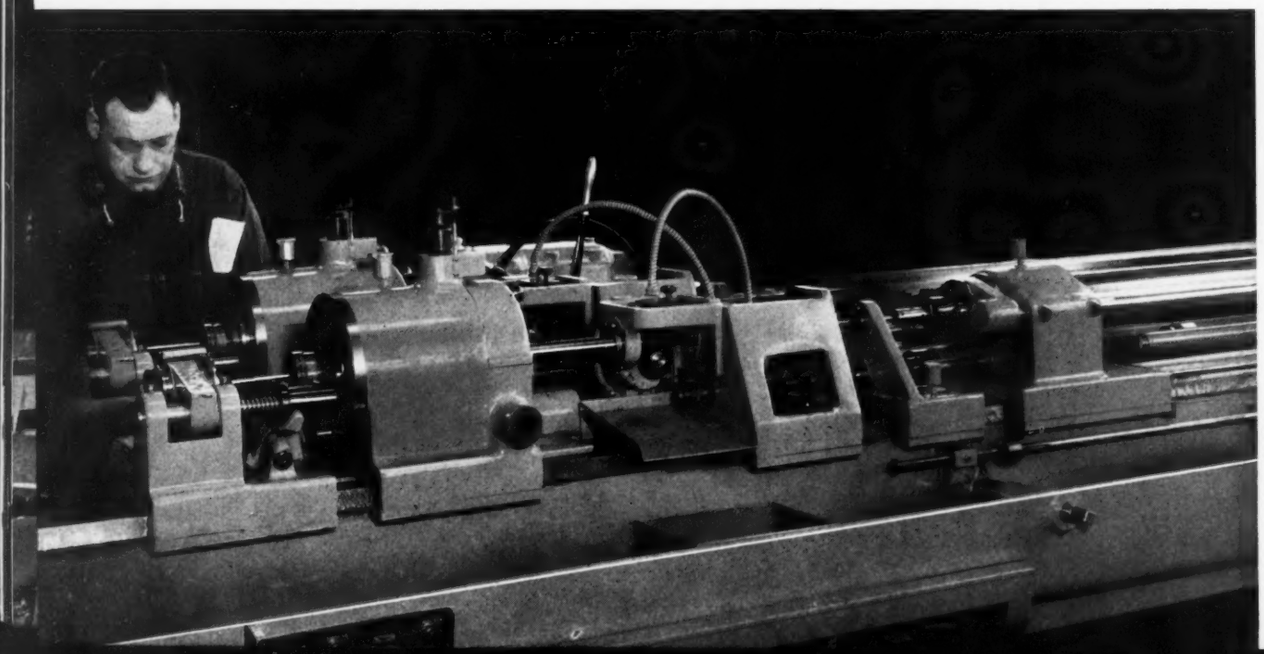
operation to serve as a guide for pilots that are integral with the various tools employed. These tools, ten in all, are mounted on the indexing head at the left. Oil is fed through the barrel to the tools.

The tools are applied in the following sequence to machine the barrel chamber: Rough-face, countersink, finish-face, first ream chamber body, second ream chamber body, third ream chamber body, fourth ream chamber body; first ream chamber neck, second ream chamber neck, and ream bullet seat. Thirteen gages are used at this machine to check the accuracy of the chamber dimensions.

After chambering, a notch or slot is milled across the breech end of the gun barrels, and then the barrels are checked for straightness in a simple machine in which each barrel is supported in a vise and sighted against a ground glass near the ceiling. A black band is painted crosswise on this glass to create a shadow in the barrel, from which the straightness can be readily determined. Corrections for inaccuracy are made by tightening the vise with the barrel properly positioned.

Similar straightening is performed after rough-turning and before reaming, the straightening inspection after chambering being merely a final check, because if the barrel is straight after drilling, it will remain so throughout the succeeding operations. The barrels are then "proof fired," sand-blasted, and Parkerized, after which they are ready for service.

Fig. 6. Duplex Rifling Machine Equipped with Lead-screws for Swiveling the Rifling Bars to Obtain the Required Helix of the Grooves



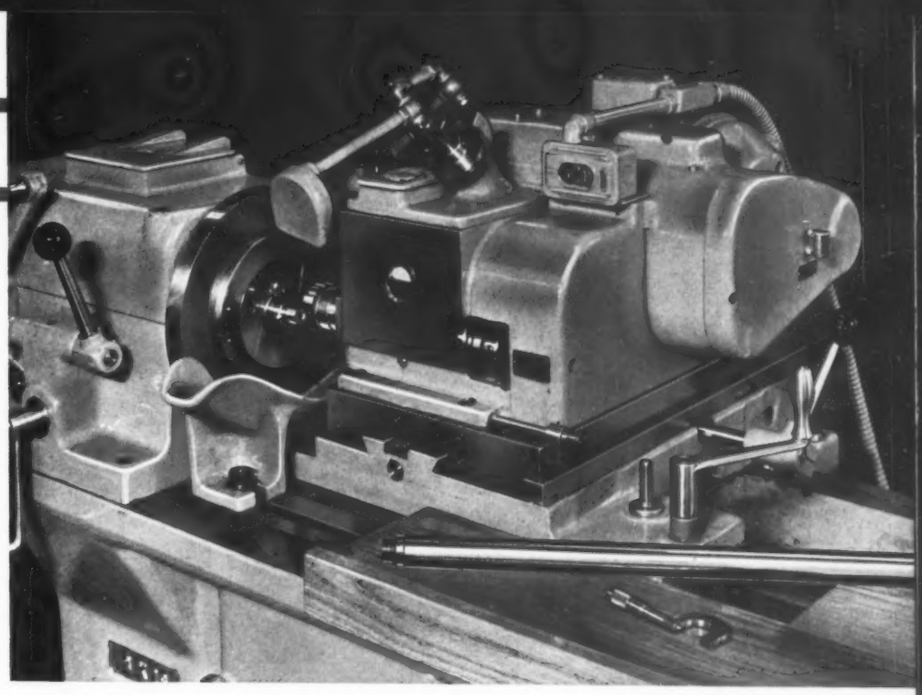


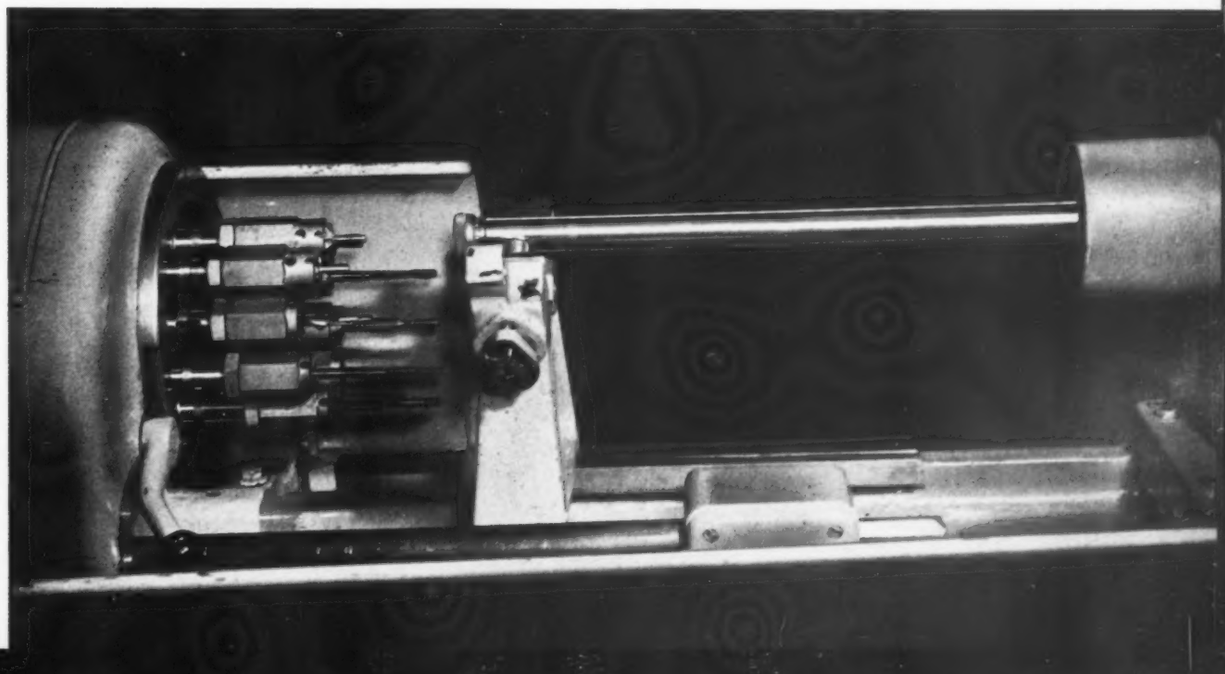
Fig. 7. Milling a Thread on the Breech End of a Gun Barrel, an Operation in which the Lead of the Thread Must be Cut True within 0.0004 Inch

Machining of the barrels is, of course, only one phase of gun manufacture. There are numerous smaller parts produced by grinding, drilling, milling, and profiling. Quite a few parts, including gun latches, are made from rectangular blocks of steel, such as shown on the magnetic chuck of the Hanchett surface grinding machine in Fig. 9. These blocks are ground to the required thickness on this machine, after which they are ground on the two edges by another Hanchett surface grinder of the type illustrated in Fig. 10. The blocks are then cut up to the proper lengths for the production of various parts.

In the operation shown in Fig. 9, five groups of twelve blocks each are ground, sixty in all. At the left is seen an indicator gage, mounted on an arm so that it can be conveniently swung across the top of the work-pieces to determine when they have been ground to the required thickness. The machine in Fig. 10 is equipped with an electric gage that comes in contact with the top of the work-pieces when the grinding wheel has been fed down sufficiently to finish the blocks to the required height. When this occurs, an electric circuit is energized, which rings a buzzer and thus notifies the operator that the parts have reached the desired size. Dimensions are held within 0.0005 inch.

A typical milling operation on one of these ground blocks is shown in Fig. 11. It consists of cutting two slots through the block after a milling

Fig. 8. Ten Cutters Mounted on an Indexing Head Automatically Perform a Series of Facing and Reaming Cuts in the Gun Chamber



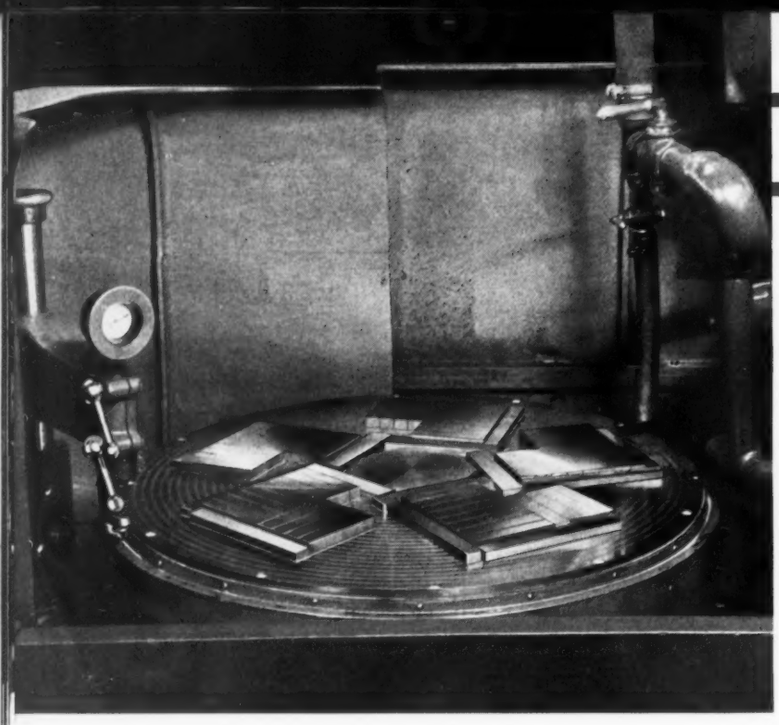


Fig. 9. (Above) Grinding Sixty Rectangular Blocks of Steel at One Time, Ready for Machining into a Variety of Gun Parts

Fig. 10. (Below Left) Grinding the Edges of Steel Blocks Accurately to Width on a Surface Grinder Having an Electric Gage

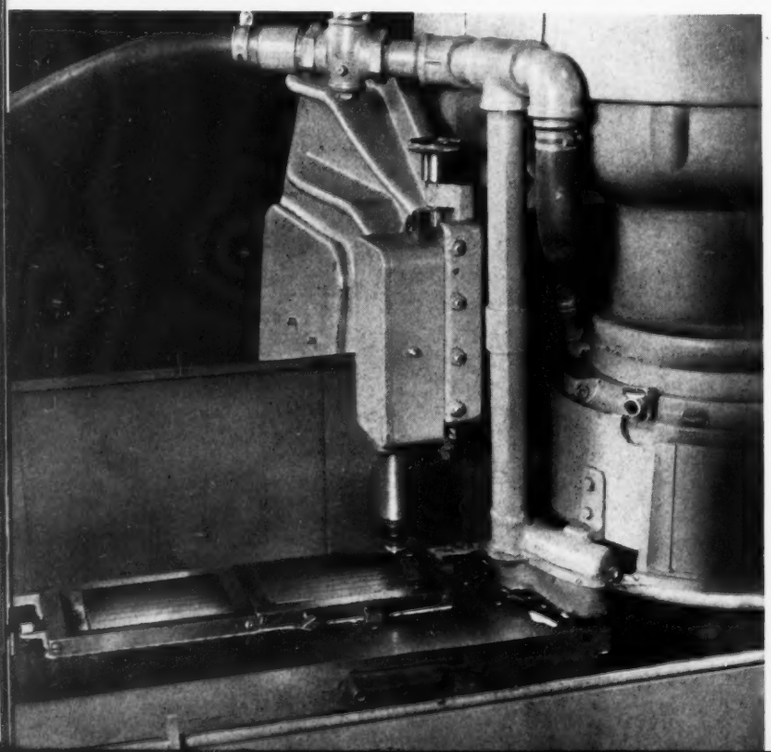
Fig. 11. (Below Right) One of a Large Number of Milling Operations Performed on Various Gun Parts

operation has been performed that cuts away material to almost one-half the width of the block and for its full length, except for two lugs on the ends. At the front of the fixture may be seen one of the blocks as it comes from the surface grinding machine, another block after the first milling operation, and a third block, at the front, as it looks upon the completion of the operation shown. The part is a bracket belt-holding pawl. The specified slot dimensions must be held within 0.001 inch. The vise in which the work-pieces are held is provided with a quick-acting clamping lever.

Another operation performed on the ground blocks after they have been cut to the proper length is shown in Fig. 12. This consists of milling two blocks at a time to an irregular contour through the use of a form cutter. The work fixture is of similar design to the one shown in Fig. 11.

In Fig. 13 is shown one of a considerable number of operations performed on Pratt & Whitney profiling machines. It consists of rough- and finish-milling the edges of the bosses at the opposite ends of a link forging, and also one side of the center boss. The tool is guided sidewise in the required path by a former pin, mounted at the right of the tool, which follows the form of a templet on the table at the right of the work. The work-table is moved in and out with respect to the cutter, and the latter is moved sidewise as required for performing the job.

When the work has been rough-milled with the



tool seen in line with the work, this tool is fed to the right, out of the way, and a second cutter-head with its former pin, at the left, is brought into position for taking the finishing cut.

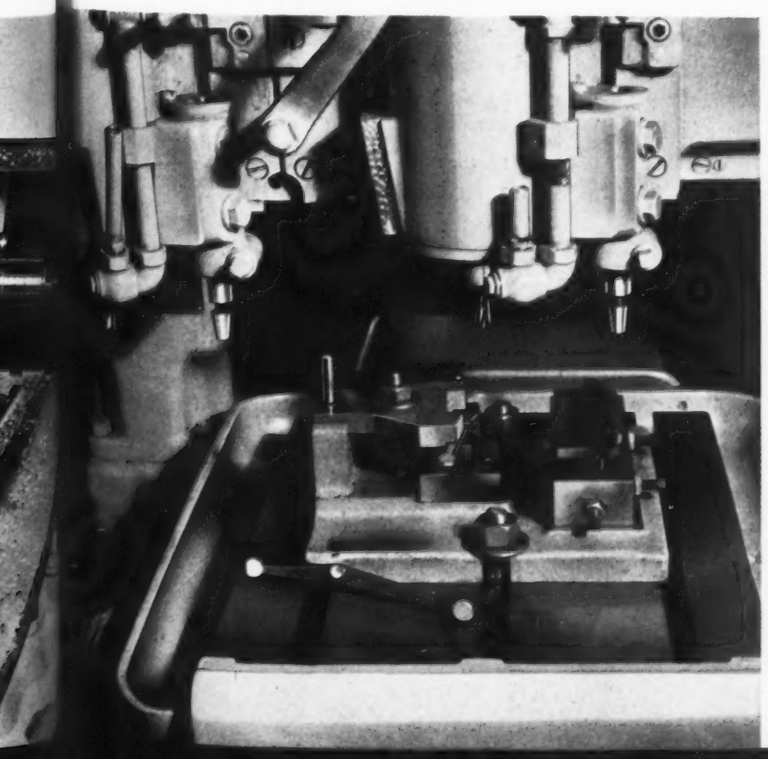
A power press operation employed for punching holes around cooling jackets made of steel tubing is illustrated in Fig. 14. The press is equipped with a Danly die, made up with a mandrel on which the tube is slipped. A series of twelve holes is drilled along the top of this mandrel to receive the lower ends of the punches when the press ram descends. With the first operation of the press, after a tube has been loaded in the die, twelve holes are punched in one row. Then the tube is indexed through 90 degrees for punching the second row of holes. Indexing is done by hand, a dowel-pin such as seen lying on the press table at the right being inserted through one of the punched holes and into a dowel-hole in the mandrel to insure correct radial positioning of the tube. Two more rows of twelve holes each are punched, after additional indexings of 90 degrees each.

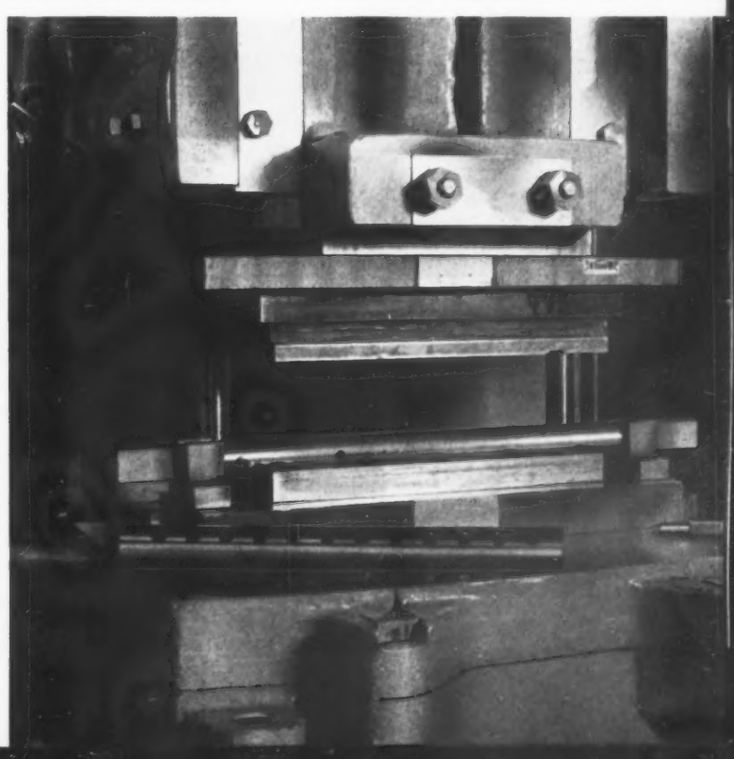
When a lot of cooling jackets has been run through this operation, one of the punches is removed from the press to permit punching eleven holes in rows between the holes already punched, and with the holes staggered. A stop which insured proper endwise location of the cooling jackets in the first operation is shifted to a new position in order to locate them accurately for the staggered punching.

Fig. 12. (Above) Another Milling Operation in which a Form Cutter is Used, Two Blocks being Machined at One Pass of the Work

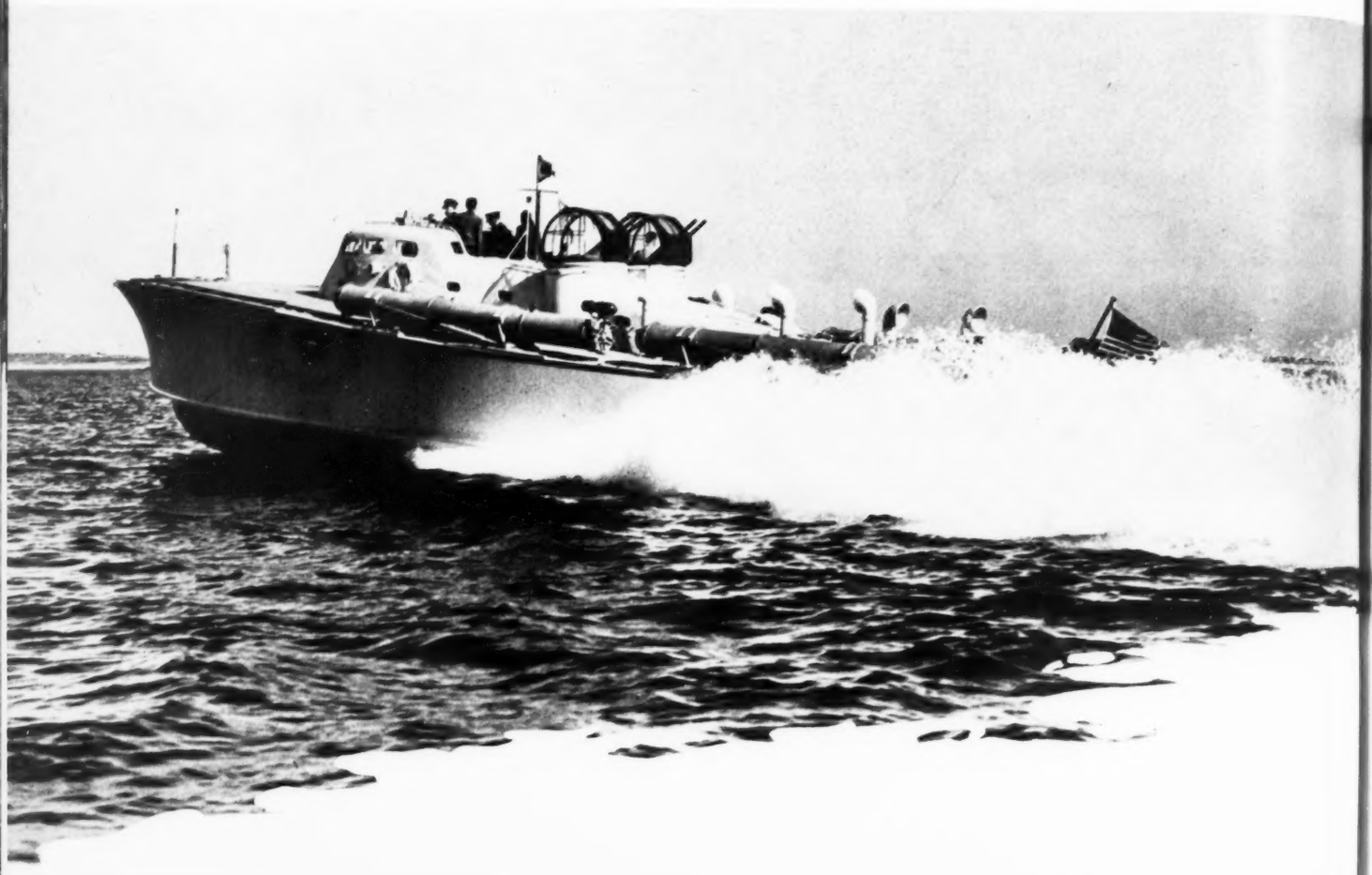
Fig. 13. (Below Left) Typical Profile Milling Operation, in which Roughing and Finishing Cuts are Taken

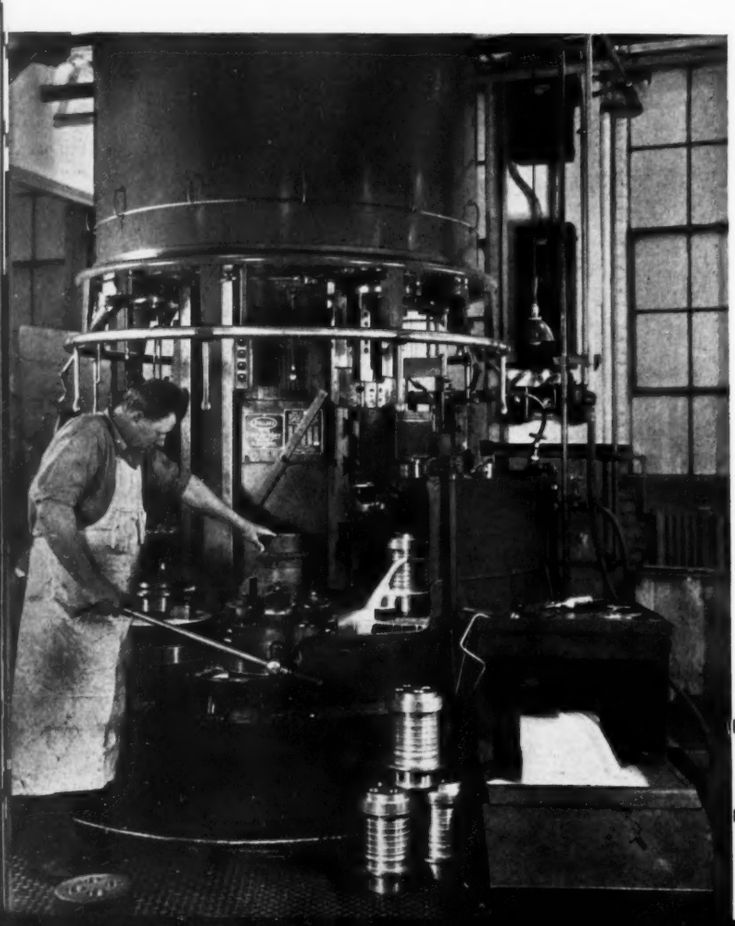
Fig. 14. (Below Right) Die Equipment for Punching Four Rows of Twelve Holes and Four Rows of Eleven Holes in Cooling Jackets





Packard Marine Engines





SMALL patrol torpedo boats capable of speeds faster than 70 miles an hour are a recent development of the United States Navy. Each of these boats is equipped with four torpedo tubes for attacking other vessels, with equipment for dropping depth charges to destroy submarines, and with machine guns for defense against aircraft and attacking vessels. Quick manoeuverability is an essential of these patrol torpedo boats. Because of their sudden attacking ability and quick getaway, they were almost immediately called "mosquito"

Cylinders for Packard Marine Engines are Completely Turned, Bored, Faced and Grooved in Two Passes around This Bullard Eight-station Mult-Au-Matic, First with the Open End up, and then with the Closed End up

Drive the Navy's Mosquito Boats

boats. The heading illustration shows one of these patrol torpedo boats of the PT10 type, which are approximately 70 feet long.

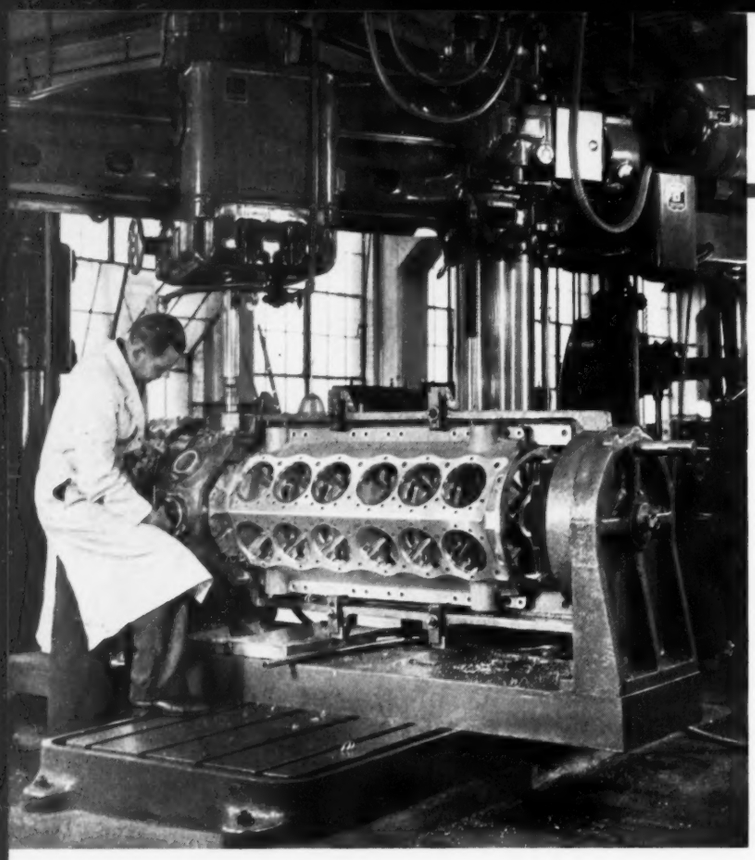
The patrol torpedo boats are driven by marine engines produced by the Packard Motor Car Co., Detroit, Mich. Three engines in one vessel supply a total of 4050 H.P. These engines are of the gasoline-driven, liquid-cooled aircraft type, with twelve cylinders arranged in two banks to form a vee. The engines weigh 1950 pounds apiece. They were developed by the concern mentioned over a period of approximately two years and at an investment cost of about $1,000,000.

During the period of development there was no indication that the engines would suddenly be required in large quantities, and therefore, plans could not be made for mass production. Upon successful demonstration of the capabilities of this engine, the Navy Department ordered six, then ten, and then suddenly, with the passing of the National Defense legislation and appropriations, seven hundred. Quickly a production of two engines per day was attained, and by May 1 it will be stepped up to three engines per day. Several hundred have been supplied to the United States Navy and the navies of the Canadian and British Governments. Orders on the books of the concern for this engine total $17,000,000.

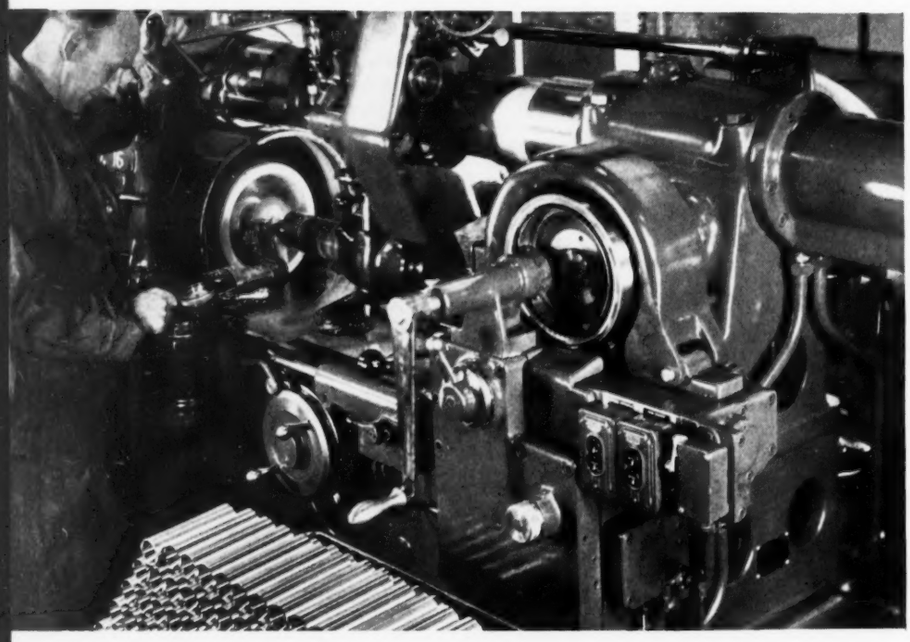
The marine engines are being produced in a building that is separate from the automobile manufacturing and assembly departments of the Packard plant. Practically every machine tool in the marine engine factory is brand new. Many of the operations reflect the latest machining practices, and for this reason a considerable number of them are shown in the following pages. It will be noted from the illustrations that almost all of the machines are of high-production types or have been equipped with jigs and fixtures that enable a multiple number of operations to be performed in one set-up of the work.

Marine engine production is, however, only one of the National Defense activities of the Packard Motor Car Co. An even more important activity is the erection of a huge three-unit plant for the manufacture of 9000 Rolls Royce aircraft engines —6000 for Great Britain and 3000 for the United States Government. This plant will have a total floor area of 1,150,000 square feet, half of which will be in new buildings and half in space existing in the present Packard plant. The Rolls Royce plant will cost about $8,000,000 and will employ approximately 17,000 men. The importance of this undertaking will be understood from the fact that normally only 10,000 to 12,000 men are employed in making Packard automobiles. The Rolls Royce engine plant will be in production by July 1, if men and machines can be obtained by that date.

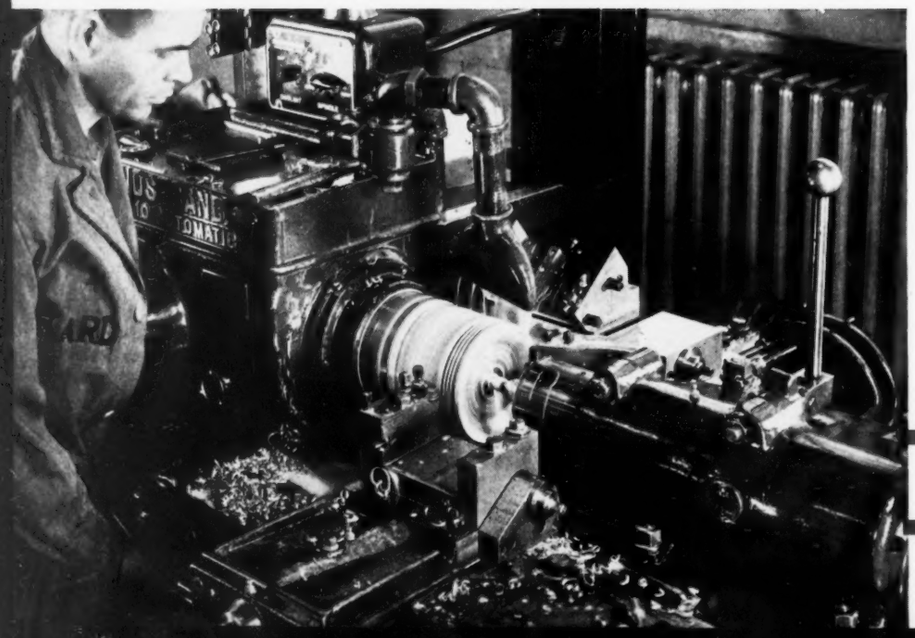
Three Connecting-rods are Milled at One Time to Required Contour along Arm and Wrist-pin Boss in a Keller Automatic Tool-room Machine. The Cutter Positions are Controlled by Templets Located above the Work



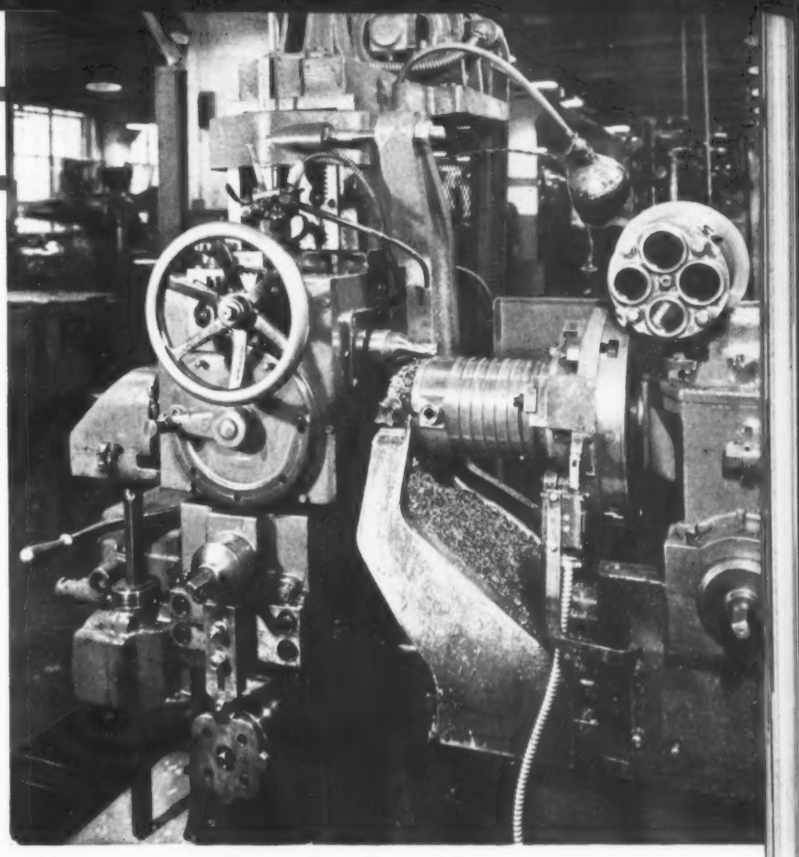
Drilling Operations on Twelve-cylinder Crankcases Performed on the Carlton Radial Drilling Machine are Facilitated by the Use of a Work-holding Fixture which can be Locked in the Required Angular Settings



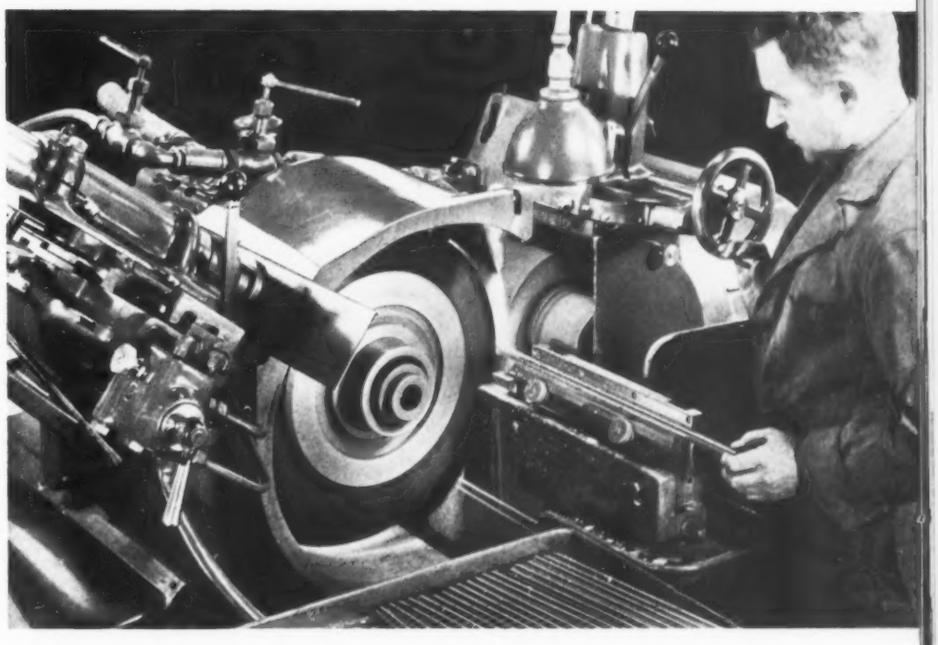
Piston-pins for Packard Marine Engines are Ground to a Taper in Each End of the Bore, then Straight for the Remaining Bore Length and on Each End Face by This Bryant Hydraulic Chucking Grinder



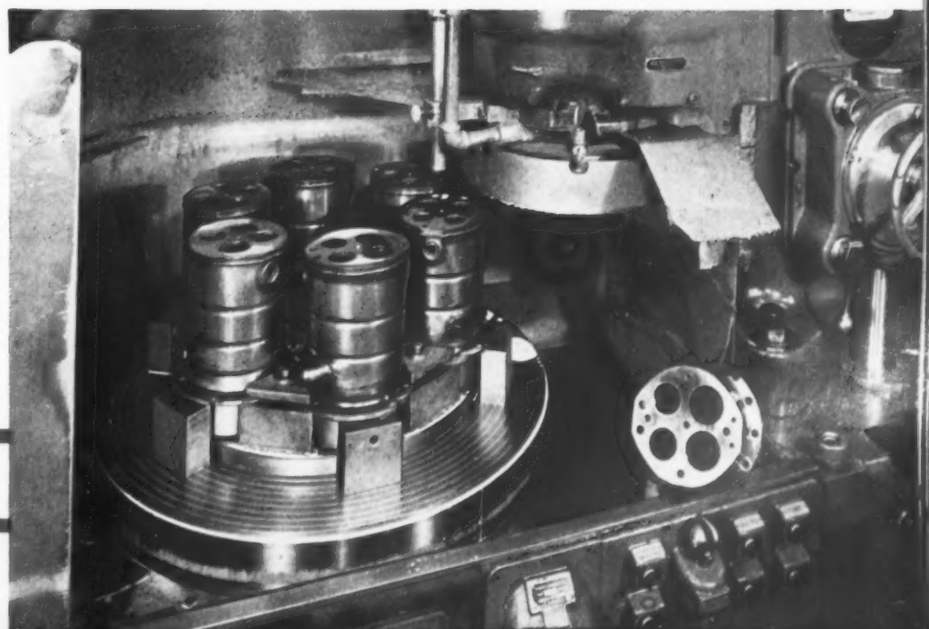
The Dome End and Ring Grooves of Pistons are Machined within Close Limits by the Use of the Sundstrand Automatic Lathe Here Illustrated. Tools on the Front Slide Cut the Grooves, while a Tool on a Rear Slide Faces the Dome



Excess Stock around the Outside of the Bosses on the Closed End of the Cylinders is Milled off by This Rowbottom Cam Milling Machine, the Cutter being Automatically Moved up and down by a Cam as the Work Revolves



Camshaft Rocker Lever Shafts, 22 Inches Long, are Ground to a Diameter of 0.4995 to 0.5000 Inch for Their Entire Length with One Pass between the Wheels of the Cincinnati Centerless Grinder Here Shown

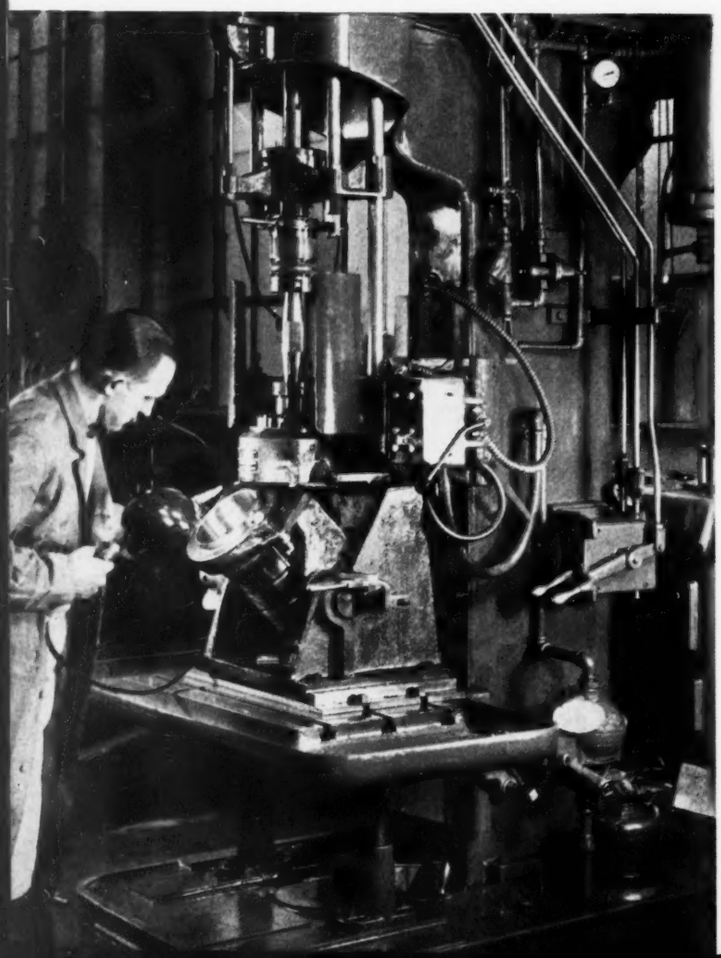


After Water Jackets and False Tops have been Welded to the Cylinders, the False Tops are Finished Six at a Time on a Blanchard Surface Grinder. Limits from This Ground Surface to Opposite End are 9.8267 and 9.8247 Inches

(Left) Bryant Two-spindle Chucking Grinder Used for Grinding the Large Bore and Finishing the Inside Faces on the Fork End of Assembled Connecting-rods and Caps. Operator is Checking Crankpin Bore with an Indicator Gage

(Lower Left) Inspecting the Bore of a Cylinder after it has been Honed to Size and to a Mirror Finish on a Barnes Hydraulically Actuated Honing Machine. The Work Fixture Tilts Forward for Cylinder Inspection and Reloading

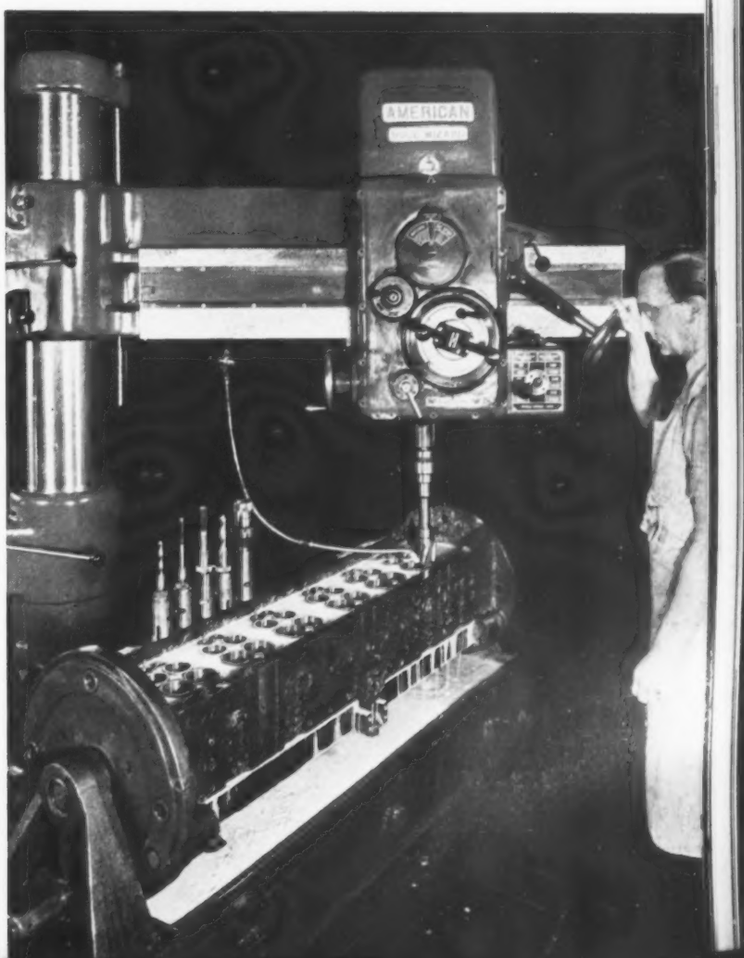
(Lower Right) Double-spindle Ex-Cell-O Precision Boring Machine Set-up for Boring the Piston-pin Hole of Connecting-rods with a Tungsten-carbide Tool and the Crankpin Hole with a Diamond

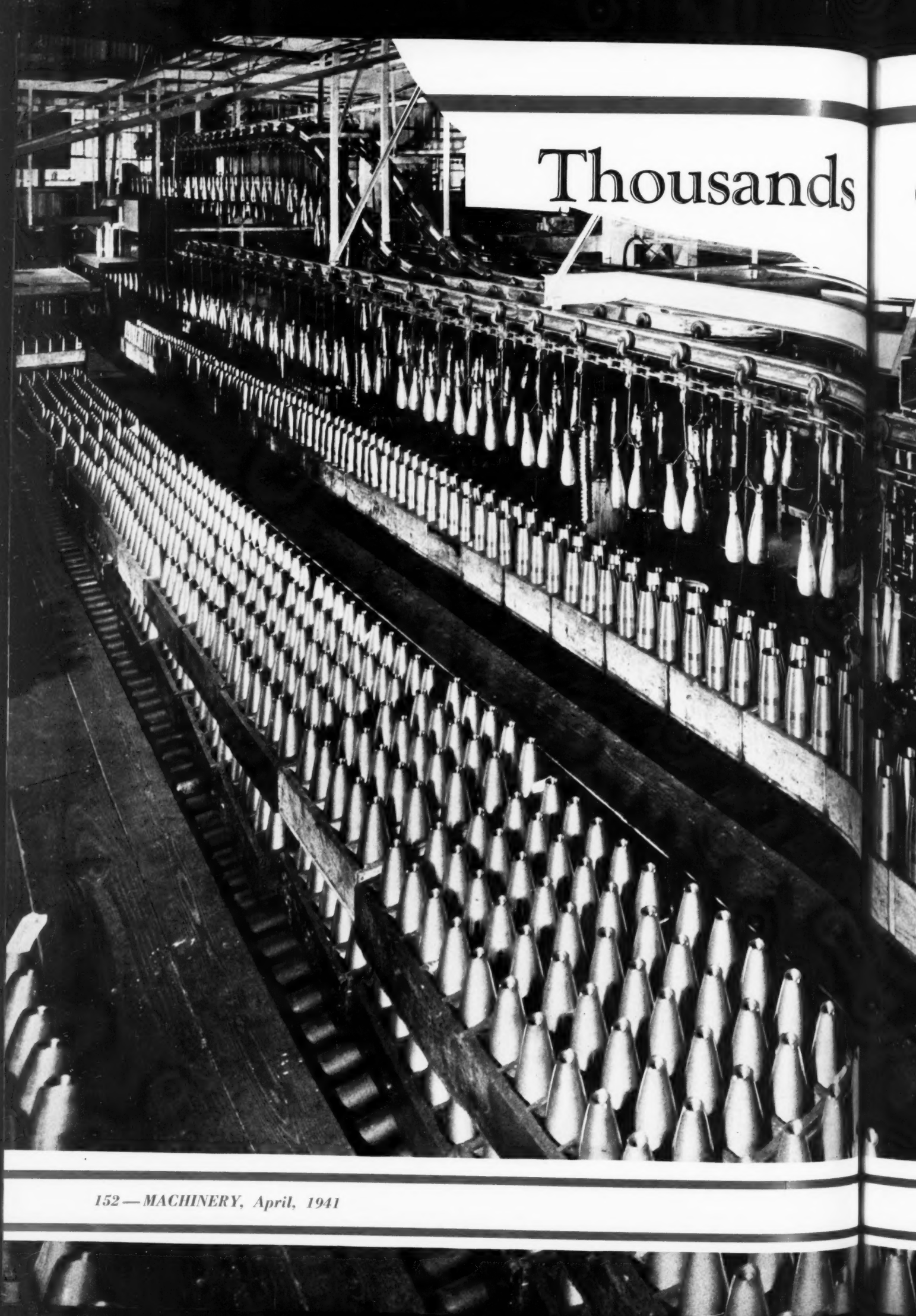


(Right) Ninety-six Holes Ranging from 5/16 to 9/16 Inch Diameter are Tapped in the Aluminum Valve Housing, after the Core Plugs and Screw Bushings have Been Assembled, by the Use of a Baush Radial Tapping Machine

(Lower Left) Grinding the Bolt Lugs on Three Connecting-rods Mounted on Their Joint Faces on a Fixture Attached to a Brown & Sharpe Surface Grinder. Quick-acting Clamps Grip Each Rod on Two Sides

(Lower Right) One Hundred and Twenty Drilling, Boring, and Reaming Operations are Performed by This American Radial Drilling Machine on the Exhaust and Intake Chambers and Other Holes in the Opposite Sides of the Valve Housings




Thousands

# of Shells Daily by Real Mass Production Methods

Over 22,000 Shells are Being Turned out per Twenty-Four Hour Day by the Budd Wheel Co., which has Also Doubled the Production of Its Normal Products

By CHARLES O. HERB

MASS production, as perfected by the automotive industry, has been applied by the Budd Wheel Co., Detroit, Mich., to the manufacture of shells for the United States Army. The result—an average production of more than 22,000 shells of seven different types per day of twenty-four hours.

This manufacturing venture into a field entirely unrelated to the normal products of the concern has been accomplished without any curtailment of regular production. In fact, the production of wheels for automobile and motor trucks—the customary business of the concern—has doubled during the time that shell manufacture has been under way.

The forge shop which has been set up in the Budd plant for the production of shells is one of the most modern in the entire world. High-frequency electromagnetic induction units, built by the Budd Wheel Co., are provided at each forging machine for heating the stock prior to forging. By the use of these units, scale is practically eliminated in the forged shells, and smoke, heat, and dirt are greatly reduced. Electrical current for the induction heating units is transformed from 60 cycles,

Fig. 1. Five Different Types of Shells Forged from Bar Stock, and a Sixth Type that is Produced from Seamless-steel Tubing

4600 volts to 3000 cycles, 800 volts in a central power distributing plant that is completely isolated from the forge shop. This plant has a total output of 3350 kilovolt-amperes, or 4500 H.P.

The forge plant is equipped with twelve National forging machines ranging in capacity from 3 to 7 1/2 inches. They produce forgings for 60- and 81-millimeter trench mortar shells, 3-inch anti-aircraft shells, and 90- and 105-millimeter artillery shells. Two shells are forged from one billet, as indicated at the bottom of Fig. 1, which shows five different types of shells produced by the forging machines, and, in addition, the shell at the upper right which is produced from seamless-steel tubular stock. The 81-millimeter high-explosive and chemical shells are of this tubular type.

The bar stock from which the shells are forged is purchased in lengths of 15 or 16 feet, the lengths being calculated so as to obtain an even number of shells with minimum stock waste. In making the 3-inch and 90- and 105-millimeter shells, specimens for chemical and physical analyses are taken from the bar stock, but in making the trench mortar shells, the specimens are cut from the forgings themselves. Specimens are examined from each heat of steel. The bar stock for 60- and 81-millimeter shells is S A E 1314 steel, and for the other shells, S A E 1335 steel.

Billets for forging the shells are cut from the bars by Racine hydraulic sawing machines of the type shown in Fig. 3, which are loaded with a number of bars for simultaneous cutting. In the particular operation illustrated, for example, thirty-five bars of steel are cut at one time for producing seventy shells of the 60-millimeter size. The bars are held securely on the carriage of the machine by hydraulically actuated vise jaws at the front of the table, and also by an additional hydraulically operated member which is pushed downward on top of the bars on the opposite side of the saw frame from that illustrated. The bars are supported for their full length by the carriage, which automatically feeds them forward past the saw, upon the completion of each operation, to position them for the next operation. Sawing of the billets provides a clean square end and facilitates proper centering by the first punch of the forging operation.

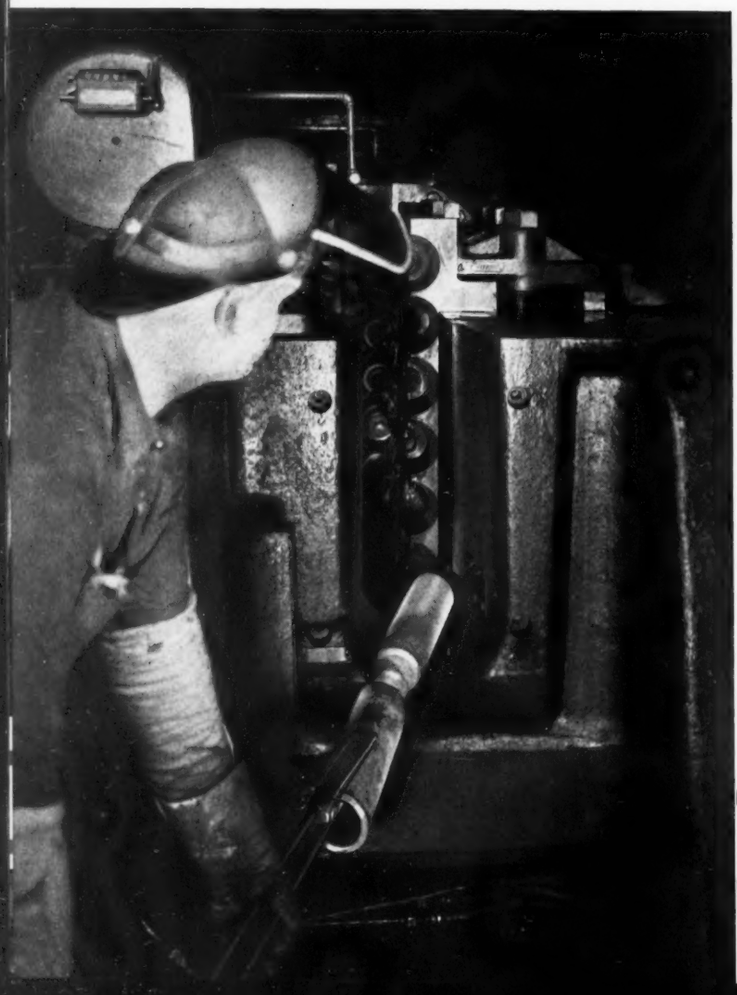


Fig. 2. Close-up View of One of the Forging Machines Employed for the Production of 90-millimeter Shell Forgings

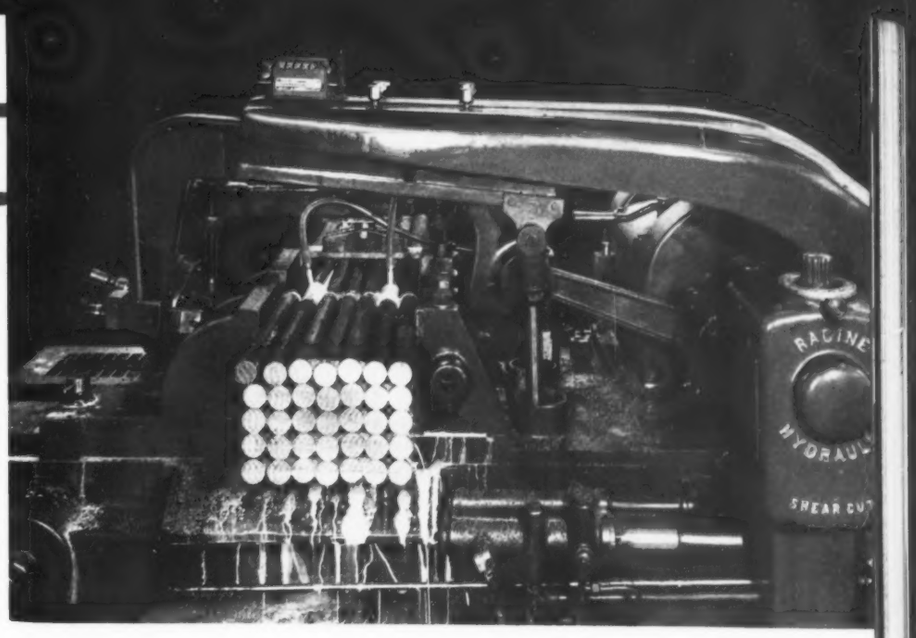


Fig. 3. Cutting Thirty-five Bars of Steel to Length in One Operation, Ready for Forging Seventy Shells of the 60-millimeter Size

The billets are heated, one end at a time, in the high-frequency electromagnetic induction heaters provided adjacent to each forging machine. After the forging machine helper places one end of a billet into the heating coil of one of these heaters, the operation is completely automatic. Only eight seconds is required to heat the stock for 60-millimeter shells to a forging temperature of 2000 degrees F., twenty-eight seconds for heating 1 3/8-inch stock for 81-millimeter shells, and one hundred seconds for heating 2 5/8-inch stock for 90-millimeter shells. Heating of the stock is accomplished so quickly that there is no grain growth in the steel. Because the heat is confined within these induction heaters, the temperature in the forge shop is always comfortable.

A close-up view of a 5-inch forging machine equipped for forging 90-millimeter artillery shells is shown in Fig. 2. The dies employed for this operation are made with six cavities and there are six punches to correspond. When the heated billet is placed in the first die cavity, at the top, the corresponding punch is advanced to make a small impression in the center of the billet and start opening up the stock. In the three succeeding die cavities, the hole is gradually pierced in the shell to its approximate size and a neck is formed in back of the shell with the forging of the closed end. When the billet is placed in the fifth die cavity, a ring that has been formed at the mouth or open end of the shell is trimmed off. Finally, the shell is finished to size, both inside and outside, in the sixth cavity of the dies.

A close forging tolerance must be maintained, because the hole in the shell is not machined. Also, owing to this fact, a high degree of smoothness in the shell cavity must be attained, and the cavity must be practically free from scale. Some of the forging machines are provided with seven-cavity dies and a corresponding number of punches instead of six, as in the case shown.

In producing the 90- and 105-millimeter shells, the second shell is forged on the billet while the first one is still integral with the stock, but in making the smaller sizes, the first shell is cut off before the second one is forged, so as to avoid reheating of the first shell, which would occur if it were attached to the billet when the stock was

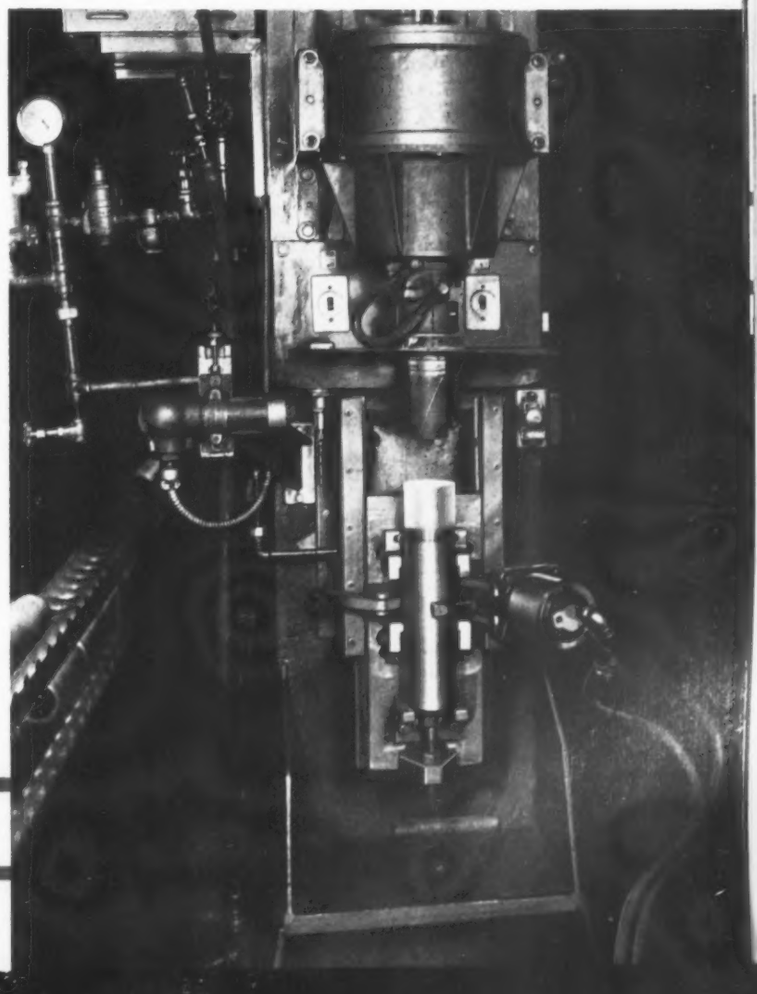


Fig. 4. Vertical Type of Induction Heating Unit Used in Preparing Ends of Tubular Shells for Swaging and Forging

Fig. 5. Swaging Machine Used in Forming Tail End of Shells that are Produced from Seamless-steel Tubing

heated for the second forging operation. In all cases, the billet is allowed to cool completely after the first forging operation before it is heated for forging the second shell.

The methods employed in forging the 81-millimeter high-explosive and chemical shells from tubular stock differ considerably from the practice thus far outlined. These shells are made from S A E 1335 seamless-steel tubing, which is cut off to lengths of approximately 16 inches and then turned in Fay automatic lathes to make the outside of the tubes concentric with the inside within a close tolerance. Each automatic is equipped with eleven tools to speed up the turning operation.

From the automatic lathes the tubes slide down gravity conveyors to the vertical type of induction heating machine shown in Fig. 4, which brings one end of the tube to the forging temperature for a distance of about 3 1/2 inches. It will be seen that each tube is positioned vertically on a slide and gripped by a clamp that is air-actuated when the operator depresses a foot-pedal. The operator then pushes a button to start the heating cycle, during which the slide that carries the tube rises to bring the end of the tube over an overhead heating coil. As in the case of the induction heaters previously described, the shell does not actually come in contact with the heating element. The slide returns automatically to its starting position, as shown, upon the completion of the heating cycle.

The heated tube is then immediately transferred to the adjacent Etna swaging machine illustrated in Fig. 5, where the unheated end is inserted in an air-operated collet chuck mounted in the work-slide. The slide automatically advances the forward end of the tube into the swaging head at the right,

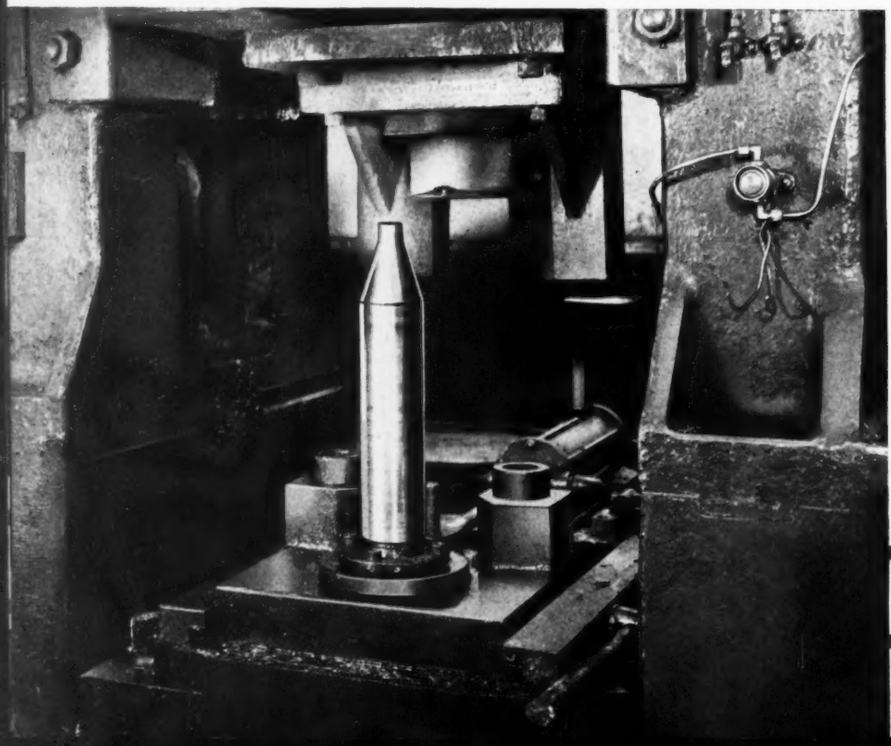


Fig. 6. Forming of the Tail End on the Tubular Shells is Completed in This Press while the Tail End is Still Hot

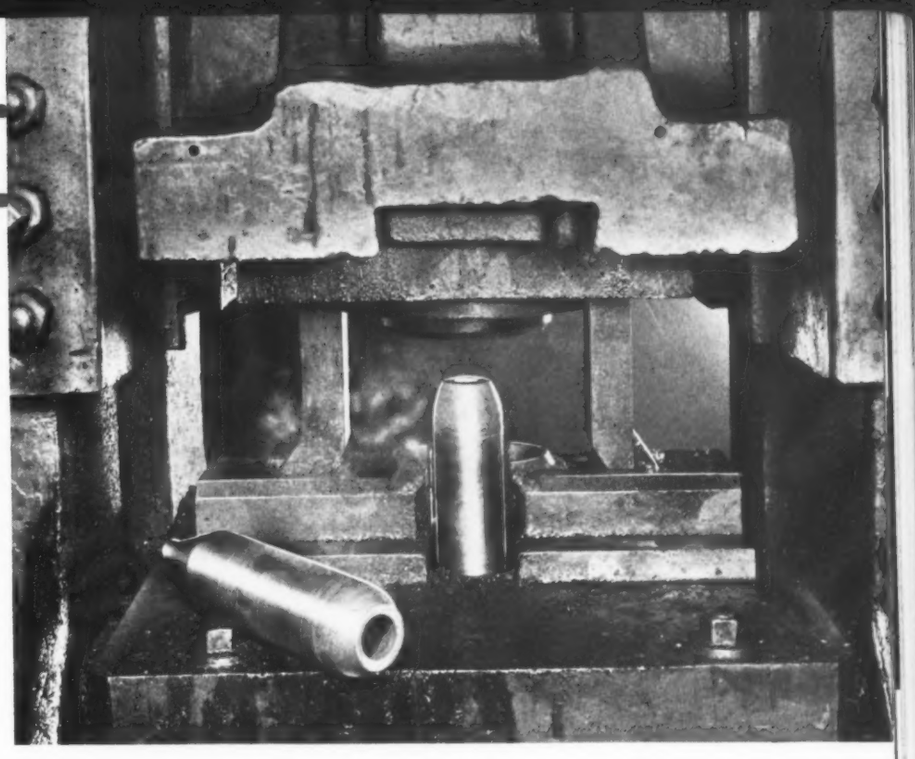


Fig. 7. Punch and Die Equipment that is Employed in Hot-forming the Nose End of the Tubular Shells

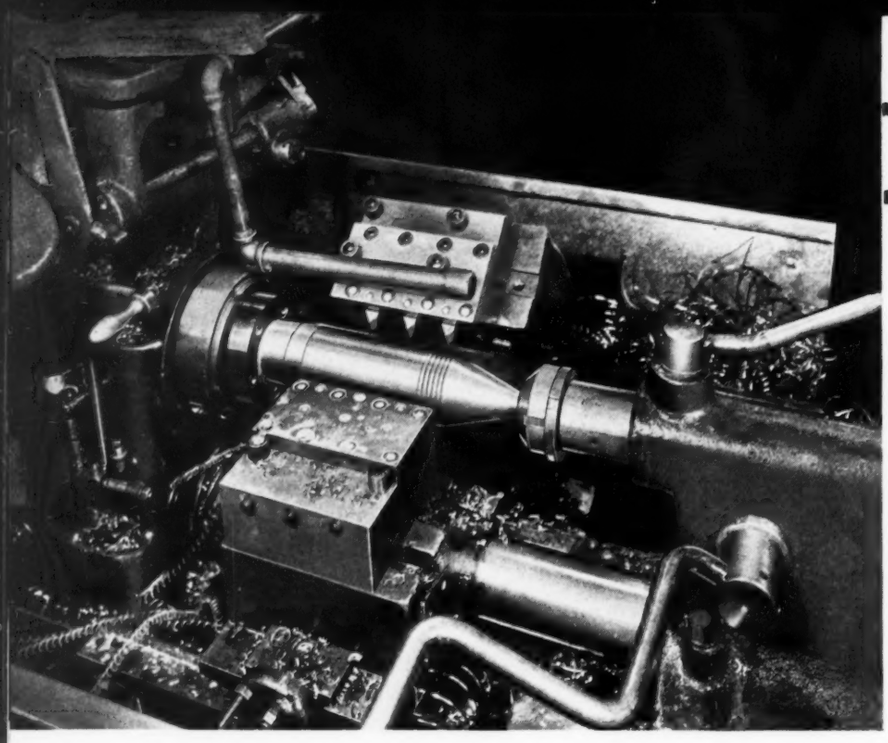
where the tube is hammered into the bottleneck shown. The air chuck that holds the tube is revolved by a motor at the back of the slide.

In the swaging operation, the outside diameter of the tube is reduced from 3 3/8 inches to 1 1/4 inches. A hole 1/8 inch in diameter is left in the "tail," as the swaged end of the tube is called. When the swaging operation is finished, the slide withdraws automatically to its starting position.

From the swaging machine the tubular shells are passed to a Toledo press equipped as illustrated in Fig. 6 for still further closing the tail end to a diameter of 1 inch and completely closing the hole in that end. For this operation, the shell is placed upright on a plug or vertical post of a slide connected to the piston of an air cylinder. The piston pulls the slide from the loading position illustrated into the working position beneath the punch, and, conversely, pushes the slide forward again when the operation is completed. By means of this slide, the operation can be performed with a much shorter ram stroke than would be necessary if the work were reloaded directly under the punch. In an operation, when the press ram descends, two pilot bars on the ram enter bushings in the slide to insure correct alignment of the work with the cup-like punch.

Upon the completion of this press operation on the tail end, the tubular shells go to another induction heater similar to the one shown in Fig. 4 for heating the large open end for a length of approximately 3 1/2 inches preparatory to "nosing" that end. After being heated, the open end of the shell is first upset slightly in an operation performed on a power press with the shell held vertically in a die. Then, with the shell still hot, "nosing" is per-

Fig. 8. Scale in the Shell Cavities is Completely Removed by Shot-blasting in the Machine Here Illustrated



THOUSANDS OF

Fig. 9. (Left) Tooling Equipment Provided on Fay Automatic for Rough-turning the Body of the Shell and Both Bourrelets

Fig. 10. (Below) General View of Shell Production Line, Showing Four Mult-Au-Matics which Rough and Finish Both Ends of the Shells

formed on the press shown in Fig. 7. This press is equipped with a split die having a plug in the center on which the tail end is seated. When the press ram descends, cam bars on the ram engage slots in the split die members and pull them together, gripping the shell securely while a hollow punch on the ram comes down and forms the nose.

Before the shells leave the forge shop, the cavities are shot-blasted to remove any scale. This operation is performed in Pangborn Airblast machines, arranged, as shown in Fig. 8, with four revolving stands on which shells can be handled simultaneously. The shells are placed vertically in revolving sleeves and supported at the top by heads

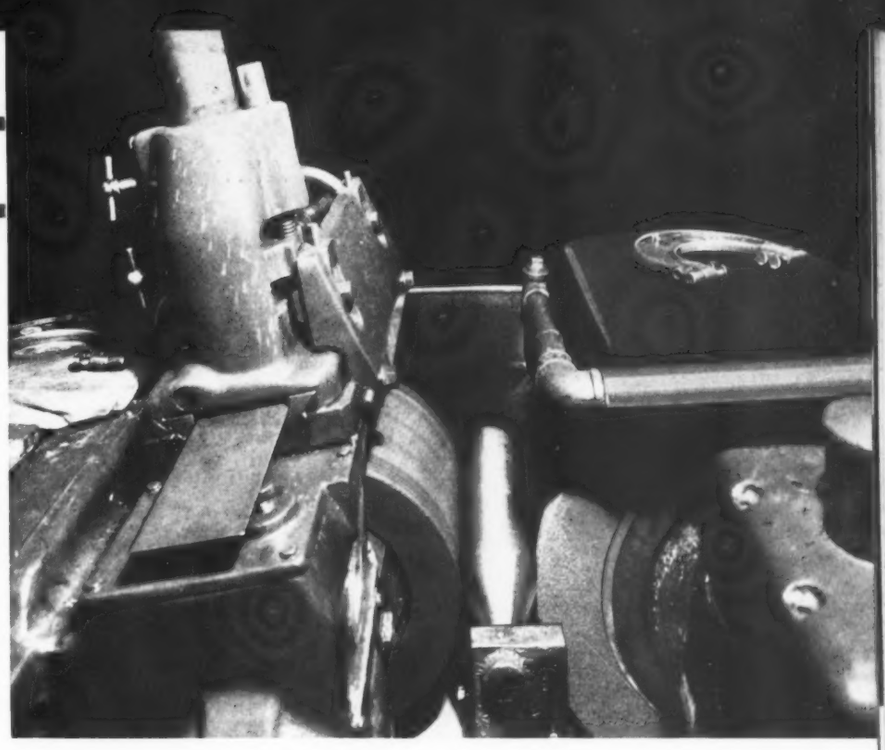


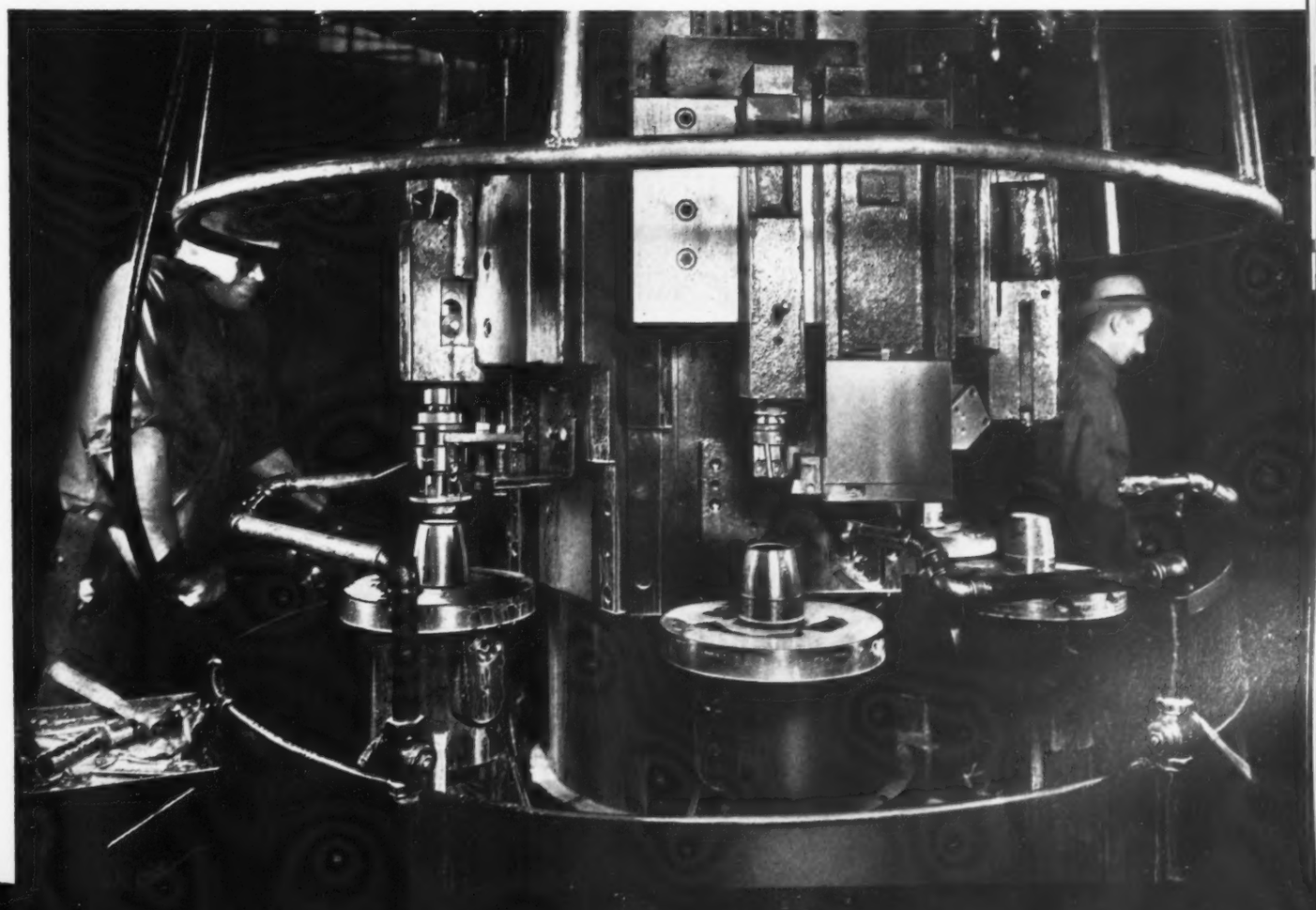
Fig. 11. (Right) Centerless Grinding Machine Used in Grinding the Bourrelet on the Two Ends of the Tubular Shells

Fig. 12. (Below) Tooling Equipment Provided on Mult-Au-Matic for Machining Nose End of Shells Produced from Seamless-steel Tubing

suspended from counterbalanced bars. These bars can be tilted toward the rear of the machine, as seen in the background of the illustration, to facilitate reloading.

With the shells and the supporting heads in position, the operator turns a handle at the front of the machine to start the blast of steel shot. The operation is timed, a light being turned on automatically when any shell has been in the machine for the allotted time. The smaller shells are shot-blasted for one minute, and the larger ones for two minutes.

The department in which the shells are machined is located adjacent to the forge shop. Gravity con-



veyors installed between the rows of machines expedite the movement of the shells from machine to machine until they reach the end of the production lines, where they are placed on overhead conveyors to be carried through a degreaser unit, to paint spraying booths, and then to final inspection, packing, and shipping tables. The heading illustration shows large quantities of shells on one of the overhead conveyors and also on gravity conveyors which lead to government inspection stations.

Complete production lines have been set up for machining each different type of shell. The first machine in all lines is a Bullard Mult-Au-Matic, which machines both ends of the shells. In the case of the 81-millimeter M43 shells, the Mult-Au-Matics machine the shells completely, except for grinding. Tungsten-carbide tools are used exclusively on the Mult-Au-Matics for turning, boring, and facing cuts.

The principal machining operations performed in finishing the 81-millimeter M56 shells (which are the ones produced from seamless-steel tubing) will now be described. The head end of two production lines for this type of shell is shown in Fig. 10. There are two Mult-Au-Matics on each side of the conveyor—a six-station machine, which is tooled up for finishing the nose end of the shells, and an eight-station machine equipped for finishing the tail end. A close-up view of the tooling on the first Mult-Au-Matic is illustrated in Fig. 12. As in conventional practice, no cuts are taken on the shells in the first or loading station of the Mult-Au-Matic. In the second station, the rounded nose of the shell and the bourrelet are rough-turned. In the third station, the bourrelet and a diameter in back of the bourrelet are finish-turned, and the shell is rough-bored at the nose end. In the fourth station, the nose end is rough- and finish-faced, and chamfered.

The contour of the nose is finish-turned in the fifth station, and the bored hole in the nose end is reamed to the minor diameter of the threads to be tapped in the sixth station. This tapping operation is performed with a Geometric collapsible tap. The fourth, fifth, and sixth stations of the nose finishing Mult-Au-Matic are seen in Fig. 12.

When the shells are indexed to the second station of the Mult-Au-Matic that machines the tail end, a cartridge container hole is drilled in the tail, the bourrelet on that end is rough-turned, and a recess is cut in the shell contour to provide a starting point for a turning tool employed in a following station of the machine. In the third station, a hole is drilled for a 1/8-inch pipe plug. The sharply tapered surface on the tail end is rough-turned in the fourth station.

In the fifth station, the bourrelet on the tail end is semi-finish-turned, and at the same time, the cartridge container hole is step-counterbored. In the sixth station, the bourrelet is finish-turned, and the cartridge container hole is reamed to two diameters by employing a step type reamer. In the seventh station, the end of the shell is rough- and finish-faced, the cartridge container hole chamfered, and four grooves are machined in the bourrelet by a form cutter. Finally, in the eighth station, the contour of the tail end is finish-turned, and the outside corner of the tail chamfered.

Following these Mult-Au-Matic operations, the shells go to Fay automatic lathes for rough- and finish-turning the cylindrical portion between the nose and tail ends. The rough-turning operation is illustrated in Fig. 9. There are three cutters on the front carriage and three on the back arm, all

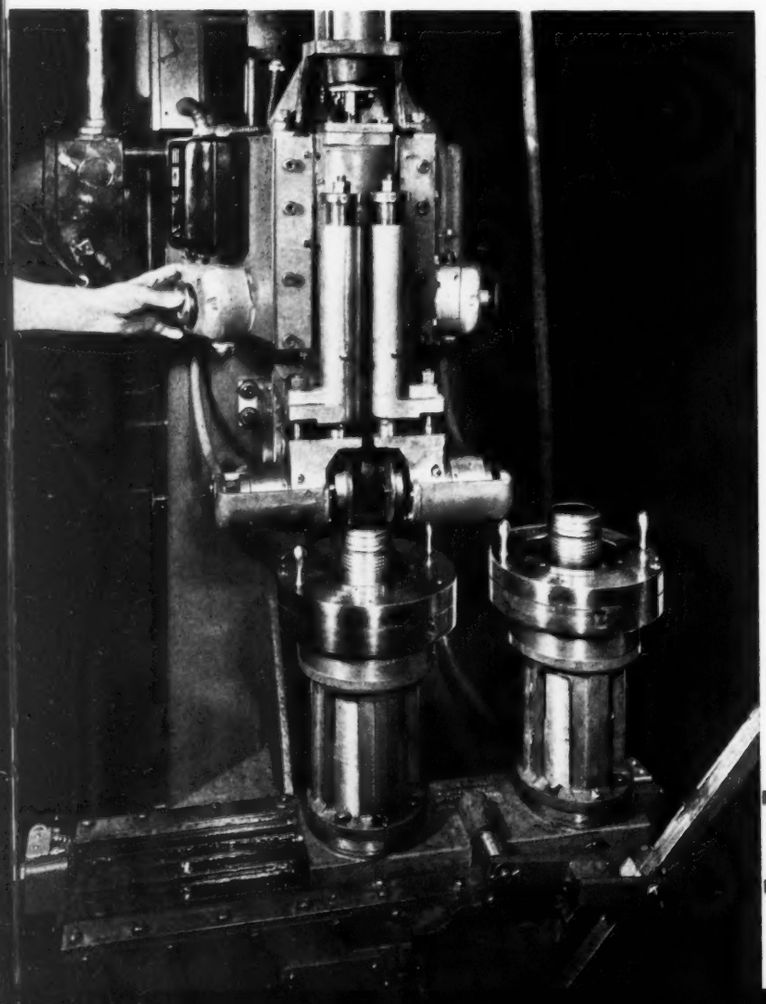


Fig. 13. Roller Type of Spot-welding Machine Used to Weld a Sheet-metal Disk on Base End of Some Types of Shells

of which are employed for turning straight surfaces. The finish-turning machine is equipped with three cutters on the front carriage only. These cutters finish the body of the shell and the bourrelets at opposite ends to two different diameters. The limits on these surfaces are plus 0.005 inch, minus nothing.

After the finish-turning operation, the shells are passed to a Cincinnati centerless grinder for grinding the bourrelets on both ends. In this operation, the shell is supported on a knife-edge rest, which tends to throw it toward the regulating wheel seen at the left in Fig. 11. The regulating wheel pushes the shell against the two grinding wheels at the right. Snap gages are used by the machine operator to check the accuracy of the ground surfaces before the shells are passed to the next machine.

Thin disks of sheet metal are welded on the base end of the 3-inch, 90-millimeter, and 105-millimeter shells. This operation is performed on Thomson roller type spot-welders such as seen in Fig. 13. These machines are equipped with two roller electrodes which ride on the thin disk as the shell revolves in the fixture. By providing two electrodes, the disk is completely welded around a circle with only one-half revolution of the shell.

Two work fixtures are provided on a slide at the front of the machine, so as to enable the operation to be performed practically continuously, with little time lost in reloading. The slide is moved quickly to the right or left by the handle seen at the right in the illustration, which is connected by a link to a pin in the center of the slide.

One of the paint spraying booths is illustrated in Fig. 14, this particular booth being set up for painting the shells produced from seamless-steel tubing. The shells reach this booth on an overhead conveyor while still hot from passing through the degreasing unit. For the spraying operation, the shells are placed on vertical spindles which carry them past two spray nozzles located within the three-sided booth at the back of the rotary table. In the first spraying position, at the right, a long nozzle is lowered vertically into each shell cavity, and as this nozzle passes up and down, black acid-proof paint is sprayed the full length of the cavity. In the second position, at the left, yellow lacquer is sprayed on the shell exterior. The shells are stationary on the rotary table until they approach the first spraying position, when they start revolving on their spindles and continue to do so until after they leave the lacquer spraying station.

Portions of the shells that are to be kept free from paint are protected by metal clips and split bands, attached to the shells when they are loaded on the revolving table. For example, three clips are provided just below the contour of the nose, and a complete band over the bourrelet grooves at the tail end. These metal pieces are held on the shell by magnetism. A plug inserted in the nose end protects the internal threads from paint, and a plug is also inserted in the tail end to keep paint from entering the cartridge container hole. DeVilbiss spraying equipment is employed. The shells dry almost instantly as they leave this machine on an overhead conveyor for the final inspection and packing tables.

Shell manufacture as described in this article indicates the production possibilities in munition manufacture when principles are applied that have long been followed by the automotive industry. The Budd Wheel Co. started equipping for shell manufacture fifteen months ago. In five months, shells were being turned out on a real production basis.

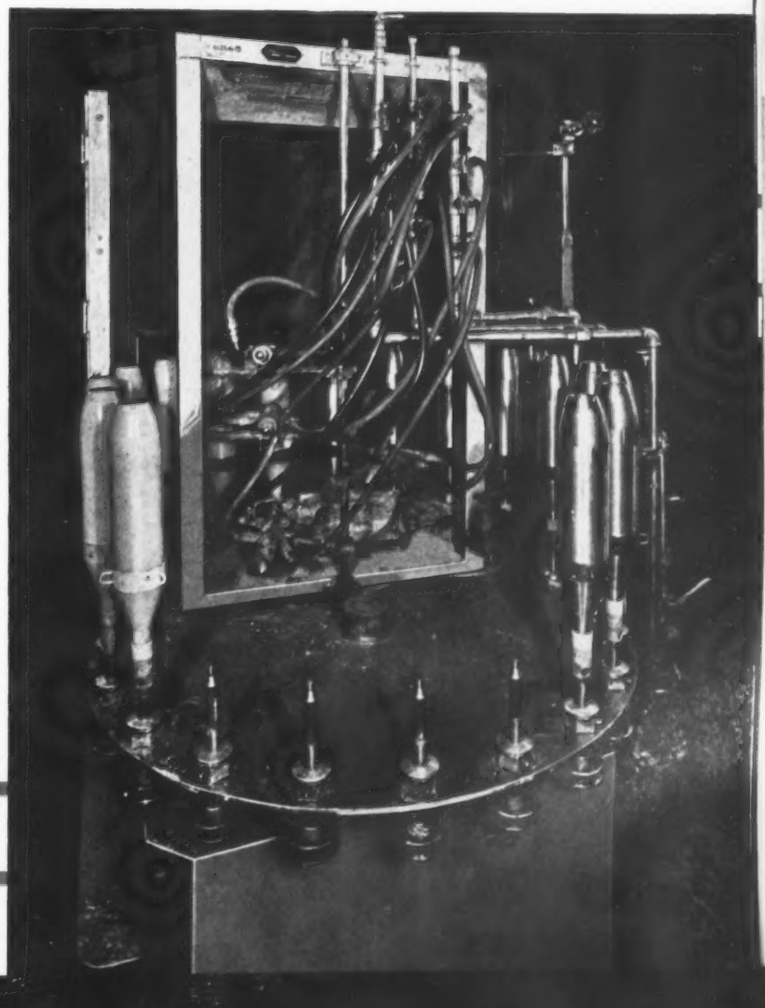


Fig. 14. Automatic Equipment for Spraying Paint in the Cavities of Shells and Lacquer on the Exterior

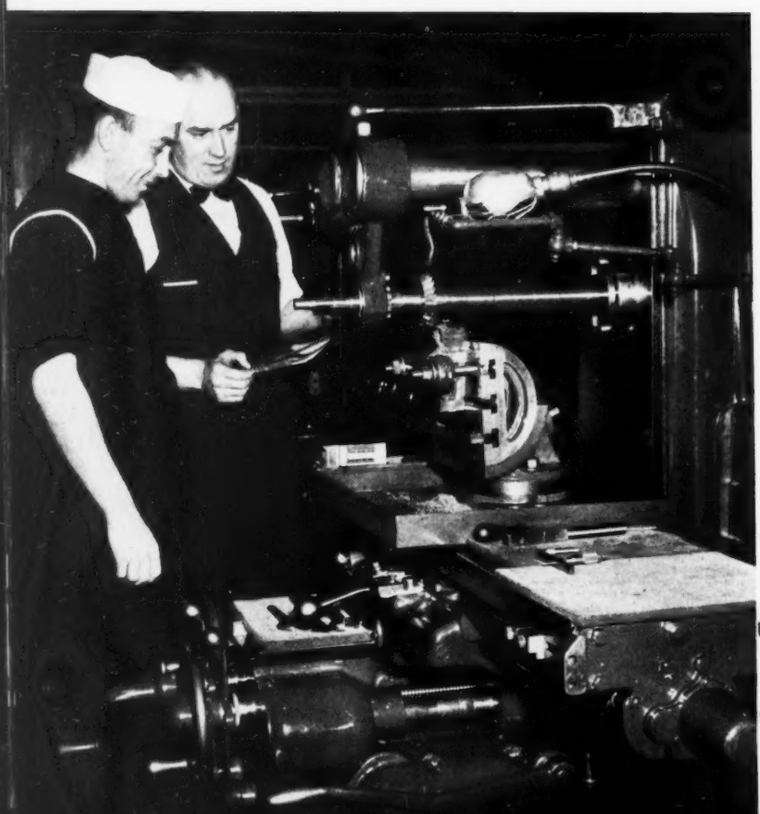
Navy Recruits

BATTLESHIPS of today are complicated pieces of machinery from bow to stern. Their personnel must, therefore, include expert machinists, electricians, ship fitters, metalsmiths, and even foundrymen. Young men skilled in these trades will soon be required in large numbers to man and service the ships of our rapidly expanding fleet.

To help train newly enlisted bluejackets for such duties, Henry Ford recently offered to the Navy Department the facilities of his huge factory and of his trade school, an offer that was quickly accepted. Mr. Ford then erected barracks, a mess hall, a recreation room, and storage buildings right in the Rouge plant at Dearborn, Mich., to accommodate the naval students, and completely equipped the buildings, all at his own expense. Even a play field was provided. This was done in the record time of forty days.

Sailor students assigned to this training school get thirty-two hours a week of practical training in the Ford shops and spend eight hours in classrooms. Instruction is given on the use and design of gages, machine shop operations, forging, welding, foundry work, carpentry, patternmaking, nickel-plating, tool hardening, boiler making, electrical engineering, steam engineering, and metallurgy. The regular methods of the Ford trade schools are followed, and all instructors are from the staffs of these schools. The commandant of the school is a naval officer, and the students are under constant naval supervision.

During the three months that each student is at the school, he is in daily contact with manufacturing operations, starting with the unloading of ore from the boats at the docks of the plant and ending



(Above) Naval Recruits, who will Soon Man and Service Uncle Sam's Rapidly Expanding Fleet, Arriving at the Ford Training School, where they will be Instructed in the Fundamentals of the Mechanical Trades

(Left) An Instructor in the Ford Trade School Explains to a Bluejacket the Purpose of a Milling Machine and how it Operates

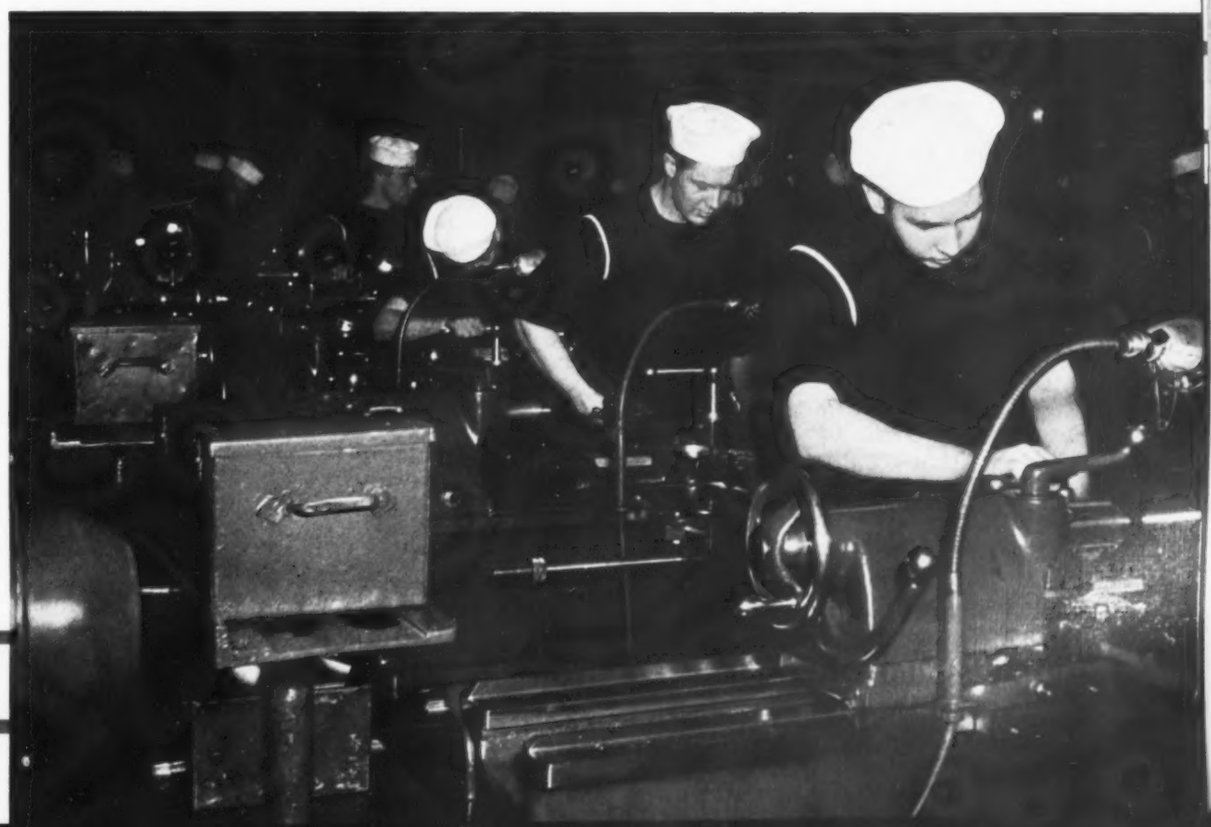
Trained in the Ford Plant

with the assembly of the finished products. The school has become the most important training center that the Navy has for training newly enlisted men in mechanical duties.

By May 1 this school will have an enrollment of 1200 naval recruits. It is planned to graduate 4500 men a year. In explaining his purpose in establishing the school, Mr. Ford said, "During the present crisis our organization wants to do everything possible to help America and the President. The Navy being our first line of defense, I feel that the training of these young men will vitally benefit our nation. And, when this crisis is over, we can then reclaim these mechanically trained young men in our industries."

(Right) Giving a Young Bluejacket Some Practical Advice Concerning the Operation of a Shaper and the Use of a Micrometer

(Below) The New Sailors Spend Thirty-two Hours a Week in Getting a Practical Shop Training. This Illustration Shows a Detail of Men Operating a Battery of Engine Lathes



Gun Bogies, Limbers, from the

MILITARY motor vehicles are being demanded by the War Department in unprecedented numbers. In this phase of the National Defense Program, the automotive industry has made great strides, and has already turned out thousands of vehicles built to meet the Army's needs. This has been possible because existing machine equipment and tooling could be immediately applied to the manufacture of Army vehicles or quickly modified to suit such production requirements.

One of the automotive parts manufacturers peculiarly fitted to fill an important role in producing military motor vehicles is the Timken-Detroit Axle Co., Detroit, Mich. For more than twenty years this company has worked closely with the Ordnance and Quartermaster Departments of the U. S. Army in developing axles and drives for motorized military equipment. As a result, when orders were first placed under the present National Defense Program, this company had the machines already tooled up to produce front driving axles, rear driving axles, transfer cases, and tandem-drive rear axle units, in the several sizes required in Army vehicles. In fact, assemblies of these types were available for supplying to truck manufacturers. The Timken-Detroit Axle Co. has received large orders from the Government for assemblies of the types mentioned, and also for complete bogies and limbers for a variety of gun carriages. Operations performed in the manufacture of Army equipment will be described in this article.

Milling operations on rear-axle housings have been facilitated by the recent installation of the Mil-Waukee-Mil illustrated in Fig. 1. The particular operation shown consists of milling several pads built up by welding on the body portion of the housing, and two additional pads located at an angle of about 80 degrees from the others. With the axle housings in another fixture of the indexing

Fig. 1. Milling Machine Used for Finishing Various Pads on Rear-axle Housings and for Milling Two Square Sections Completely around All Four Sides of the Housings

and Truck Axles Timken-Detroit Plant

The Important Role Taken by One of the Large Parts Manufacturers of the Automotive Industry in Carrying Out the National Defense Program

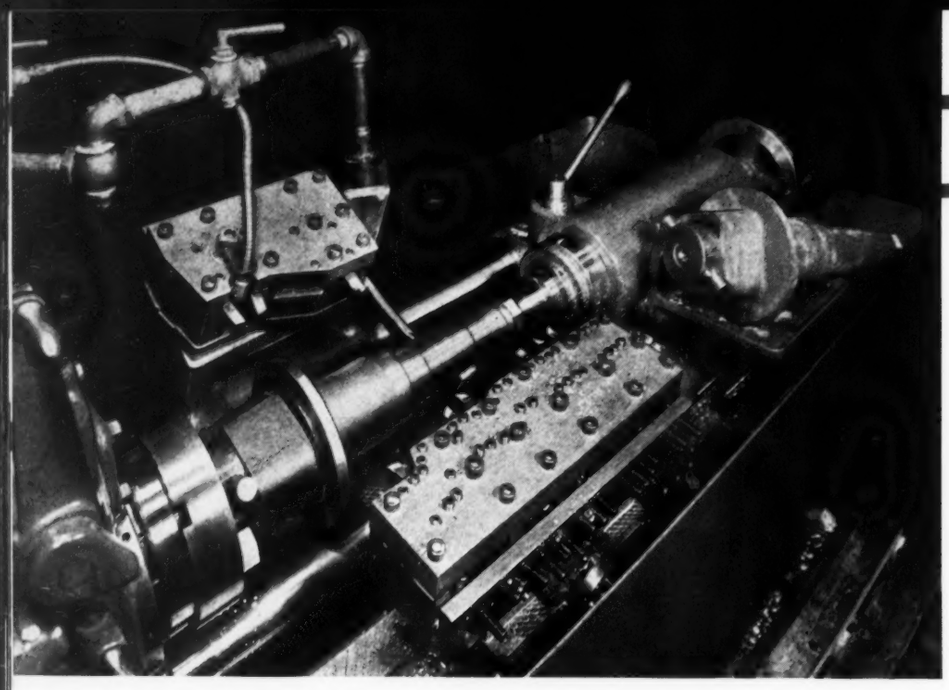


Fig. 2. (Left) Automatic Lathe Used for Finish-turning Brake Spiders after they have been Rough-turned with Similar Equipment

Fig. 3. (Below) Automatic Tooled up for the Complete Machining of Large Brake-drums, Inside and Outside, in One Operation

type, square sections between the banjo and each flange are completely milled around the four sides.

Brake spiders are rough- and finish-turned on Fay 12-inch automatics. In Fig. 2 one of the rough spider forgings may be seen lying on a tray attached to the front of the tailstock, while a finished spider is seen supported between the centers of the machine. The illustration shows the finish-turning operation. In both rough- and finish-turning, the spider forging is supported on an arbor that is slipped into previously machined bores in the part.

The rough-turning automatic is equipped with nine cutters on the front carriage, five of which are applied for turning a taper surface, and two for turning straight cylindrical surfaces, all on the shank. The eighth tool is used for turning a pilot shoulder on one side of the flange, and the ninth for turning the flange. The taper turning tools are actuated in an angular direction by a cam bar. Three cutters on an arm at the rear of the machine face the two sides of the flange and a shoulder.

The finish-turning automatic, shown in the illustration, is equipped with seven tools on the front carriage for machining six straight cylindrical surfaces on the shank and one on the flange. Three tools are provided on the rear arm for finish-turning the surfaces that were rough-faced in the previous operation. About 1/8 inch of stock is removed in roughing. Tolerances on finish-turning range from 0.004 to 0.010 inch.

Brake-drums, of nickel-alloy iron, 19 inches in diameter by 6 1/4 inches wide, are completely machined in one operation on the Potter & Johnston automatic illustrated in Fig. 3. The drums are securely held in the jaws of an air-operated chuck, which grips the drum periphery. The operation

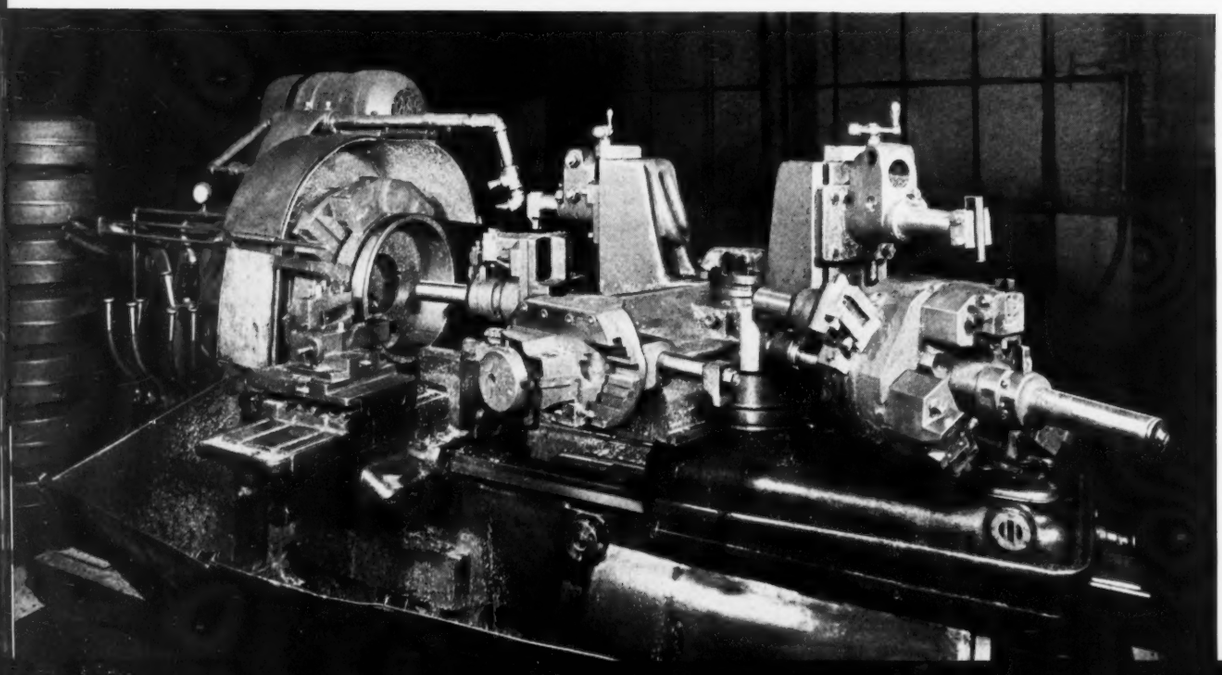


Fig. 4. (Right) Machine Employed for Grinding Beam Axles for Howitzers, which are Over Seven Feet in Length Over All

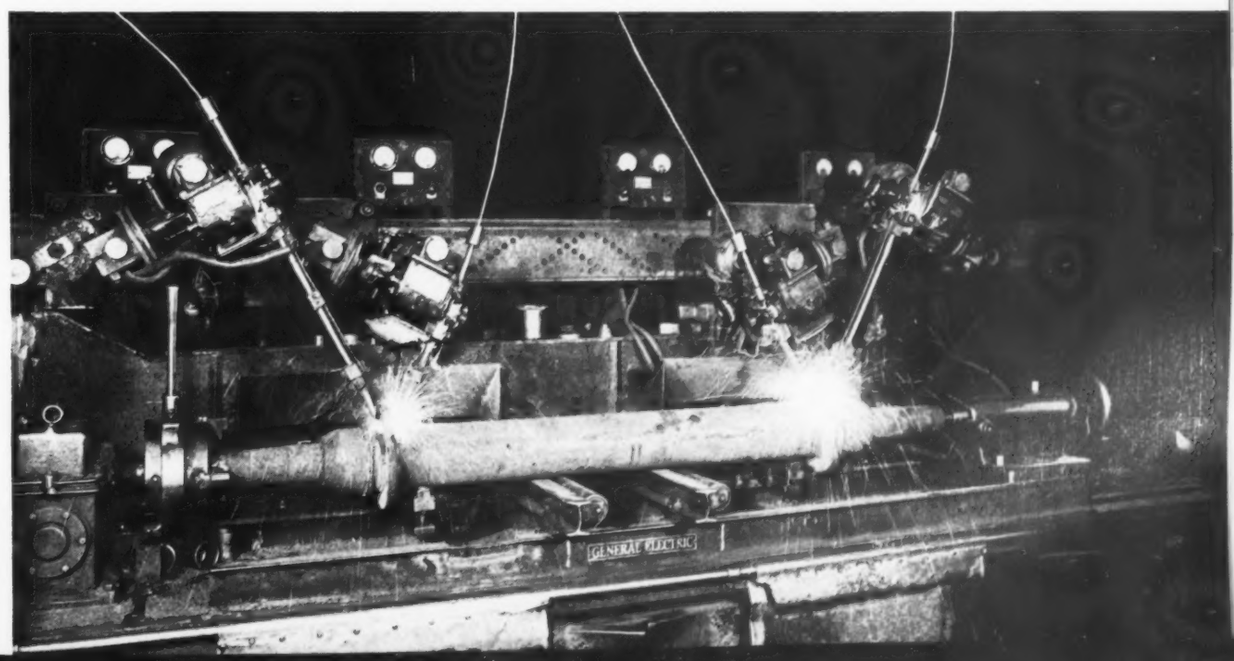
Fig. 5. (Below) Arc-welding Two Flanges to Trailer Axles by the Simultaneous Application of Four Automatic Welding Heads

consists of finishing the large bore to 17 1/4 inches diameter, within plus or minus 0.005 inch, for a length of 5 11/16 inches; boring a hole in the hub end to a diameter of 8.000 to 8.004 inches; facing both sides of the wall on the hub end; facing the open end; and turning the periphery of the drum for a width of 2 1/2 inches.

Three tools on the first turret face rough-machine the large bore, a fourth tool rough-bores the hole in the hub end, a fifth tool turns the outside diameter of the drum, and a sixth tool cuts a 1/4-inch by 45-degree bevel at the outer end of the large bore. The tools mounted on this turret face are seen at the right in Fig. 3.

Two tools attached to a slide mounted on the second face of the turret, face both sides of the wall on the hub end of the drum. In addition, one of these tools forms the beveled fillet at the inner end of the large bore. These cuts are accomplished by a bar on the rear cross-slide pushing the turret-slide sidewise after the tools have been fed into line with the surfaces to be machined, and thus causing the tools to feed across those surfaces. Upon the completion of the cuts, the tool-slide returns to its central position on the turret face, permitting the tools to be withdrawn. The cutters face to a diameter of about 13 inches. While the facing cuts on the hub end are in progress, a third tool on the rear cross-slide rough-faces the flange on the open end of the brake-drum.

Tools on the third turret face finish-bore the braking surface and the hole in the hub end, and finish-turn the large outside diameter. These tools are seen in the illustration just after they have been indexed into line with the work. While the cuts are being taken by the tools on the third tur-



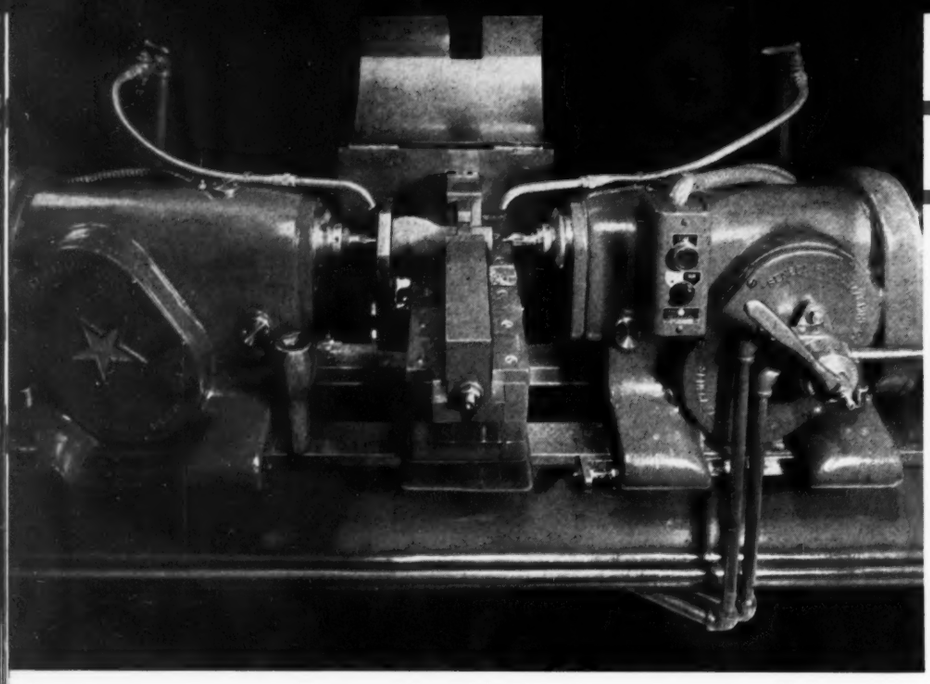


Fig. 6. Double-end Centering Machine Used to Prepare Torque-rod Pins for a Turning Operation

ret face, a tool on the front cross-slide is fed forward to finish-face the flange.

Tools on a slide mounted on the fourth turret face are then used for finish-facing the hub end of the brake-drum in the same manner as the tools used for rough-facing, except that the tools are mounted in the opposite direction to the rough-facing tools and are fed sidewise by a bar on the front cross-slide. The outer corner of the hub bore is also chamfered. The complete machining of the brake-drums is accomplished in twenty minutes.

Beam axles for 155-millimeter howitzers are shown being ground on a Norton cylindrical grinding machine in Fig. 4. The long cylindrical surface must be ground for a length of about 65 inches within a tolerance of 0.004 inch. In addition, a smaller cylindrical surface, 3 inches long, and a still smaller surface, 1 3/4 inches long, are ground on each end. A square shoulder must also be ground between the two smaller diameters. The largest diameter of the axle is about 4 1/16 inches, and the smallest 2 inches. The over-all length of the part is 88 5/8 inches. In the operation shown, the smaller diameter surfaces are being ground simultaneously on one end.

Four automatic arc-welding heads are applied simultaneously by the General Electric welding machine shown in Fig. 5 for welding two flanges to the tubular members of trailer axles. The axle is revolved beneath the welding heads by a chuck that grips it at the left end. The welding heads are so mounted on slides that they can be tilted into the required positions relative to the work. The slides can be moved longitudinally on a rail at the back of the machine and locked in desired locations. This machine has a rating of 750 kilovolt-amperes.

A group of machines has lately been installed in this plant for completely machining torque-rod ball-ends or pins which are seen in the rough-forged state in Fig. 6. The machine in this illustration is a Seneca Falls centering machine of double-end design which enables both ends of the forgings to be centered at one time. The work-piece is held in a fixture mounted on the carriage of the machine,

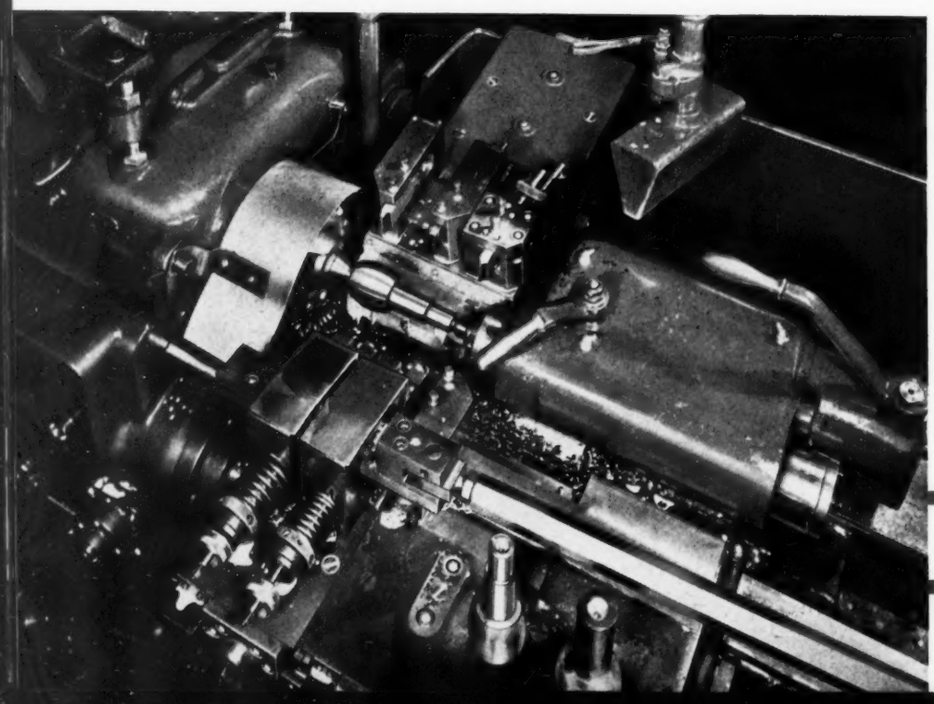


Fig. 7. Automatic Lathe Equipped with Tungsten-carbide Tools for Rapid Turning of Torque-rod Pins, which are of a High Brinell Hardness

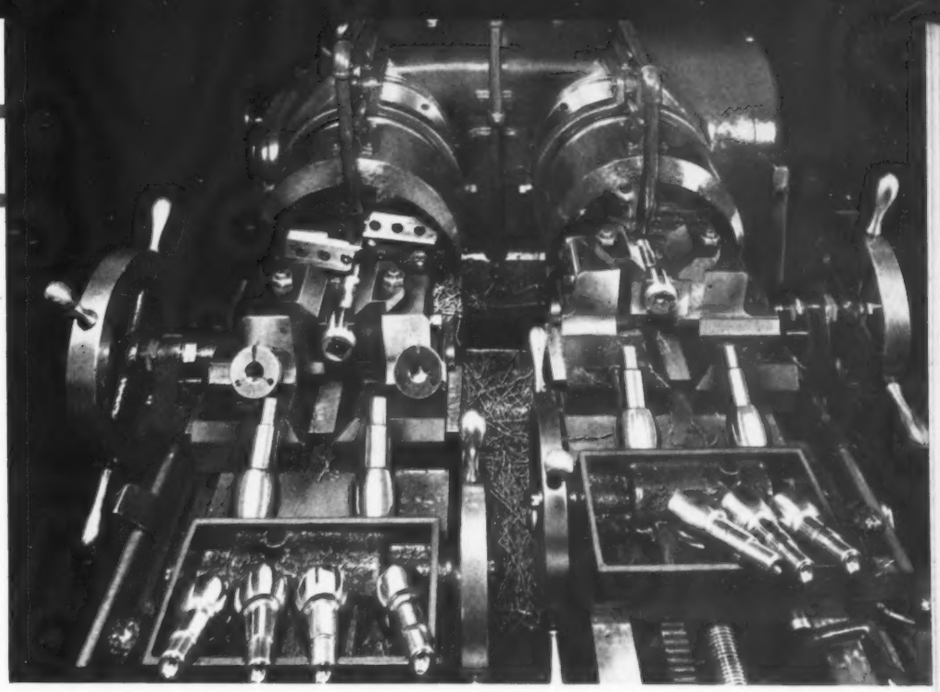


Fig. 8. Two-spindle Machine Equipped for Cutting Threads on Shank End of Torque-rod Pins

the large end of the forgings being inserted in a plate provided with a counterbored hole to suit. There is also a square shoulder on this plate on which a square socket in the end of the forging is seated to prevent the forging from turning with the centering drills. The opposite end of the work-piece is gripped by air-operated jaws on the fixture.

The torque-rod pin forgings are next completely turned in an adjoining Lo-Swing automatic lathe, shown in Fig. 7. Three tungsten-carbide cutters on the front carriage turn the large, elliptical shaped end of the part, a tapered length to the right of the elliptical head and a smaller-diameter cylindrical portion at the right-hand end. The taper and ball-end turning tools are moved in and out in relation to the work as the carriage is fed along the bed. This cutter movement is produced by rollers attached to the quills that carry the tools riding on a cam bar on the carriage. The cam bar is fastened to the tailstock so that it is held stationary as the carriage moves longitudinally.

While these turning cuts are being taken, three cutters on a slide at the rear feed forward to face and chamfer both ends of the part and also to face the shoulder where the taper and elliptical portions end. The limits on the diameter of the elliptical end are 2.305 and 2.320 inches. It has a radius of 2 3/8 inches. The over-all length of the part is 5 3/4 inches. It is made of S A E 4340 steel and has a Brinell hardness of 330 to 375. All the tools used in this operation are of tungsten-carbide.

At the end of the turning operation, the torque-rod pins are passed to the Murchey double-spindle threading machine shown in Fig. 8, which threads the shank end for a length of 1 3/8 inches. The threads are 1 inch in diameter, 14 per inch, and of American Standard form. They must pass pitch-diameter thread gages of 0.9500 and 0.9536 inch.

The work is held in carriage jaws that are shaped to the contour of the elliptical head. Swinging stops at the front and back of the machine are used to locate the front end of the pieces, these stops being swung out of the way of the die-head chasers before the operation is started.

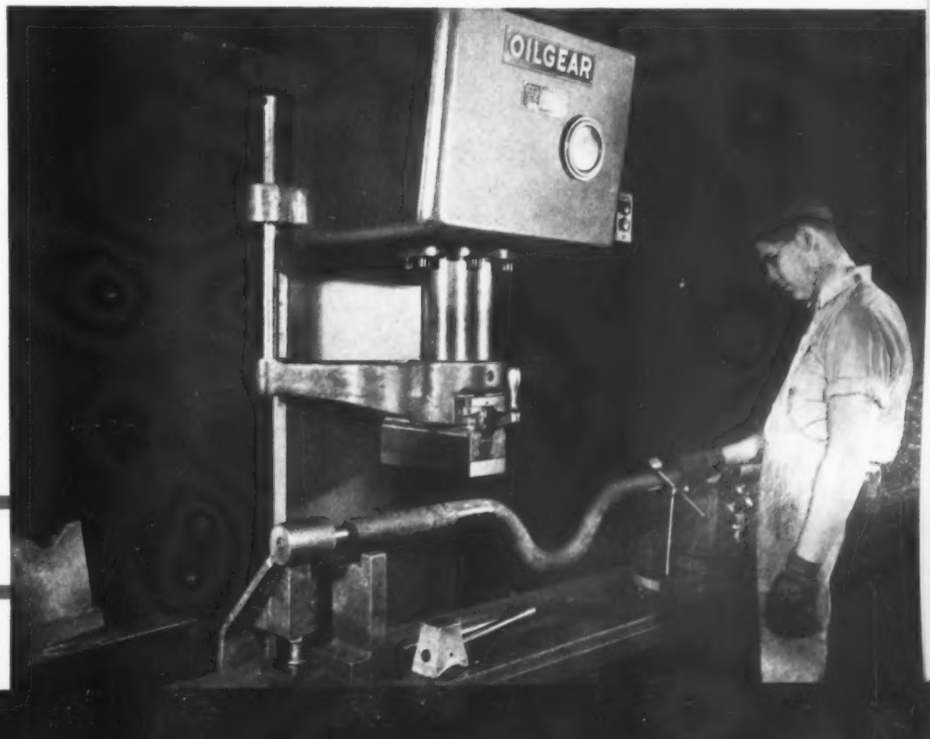


Fig. 9. Seventy-five-ton Hydraulic Press Used for Aligning the Opposite Ends of a Round Bar that has been Bent to a U-shape in the Middle

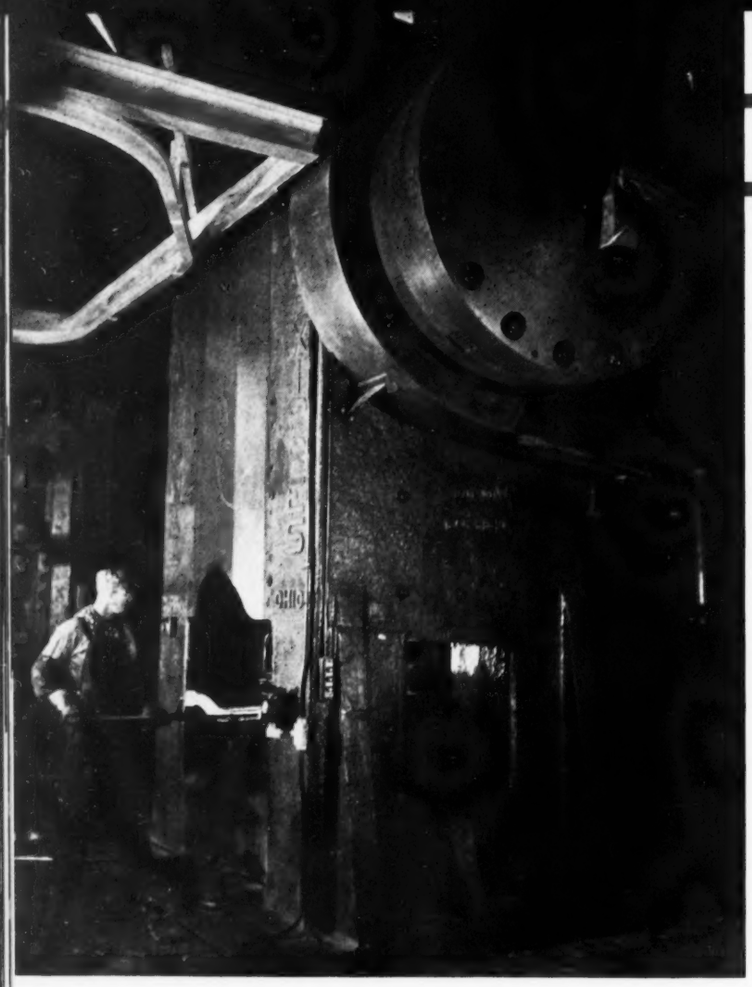


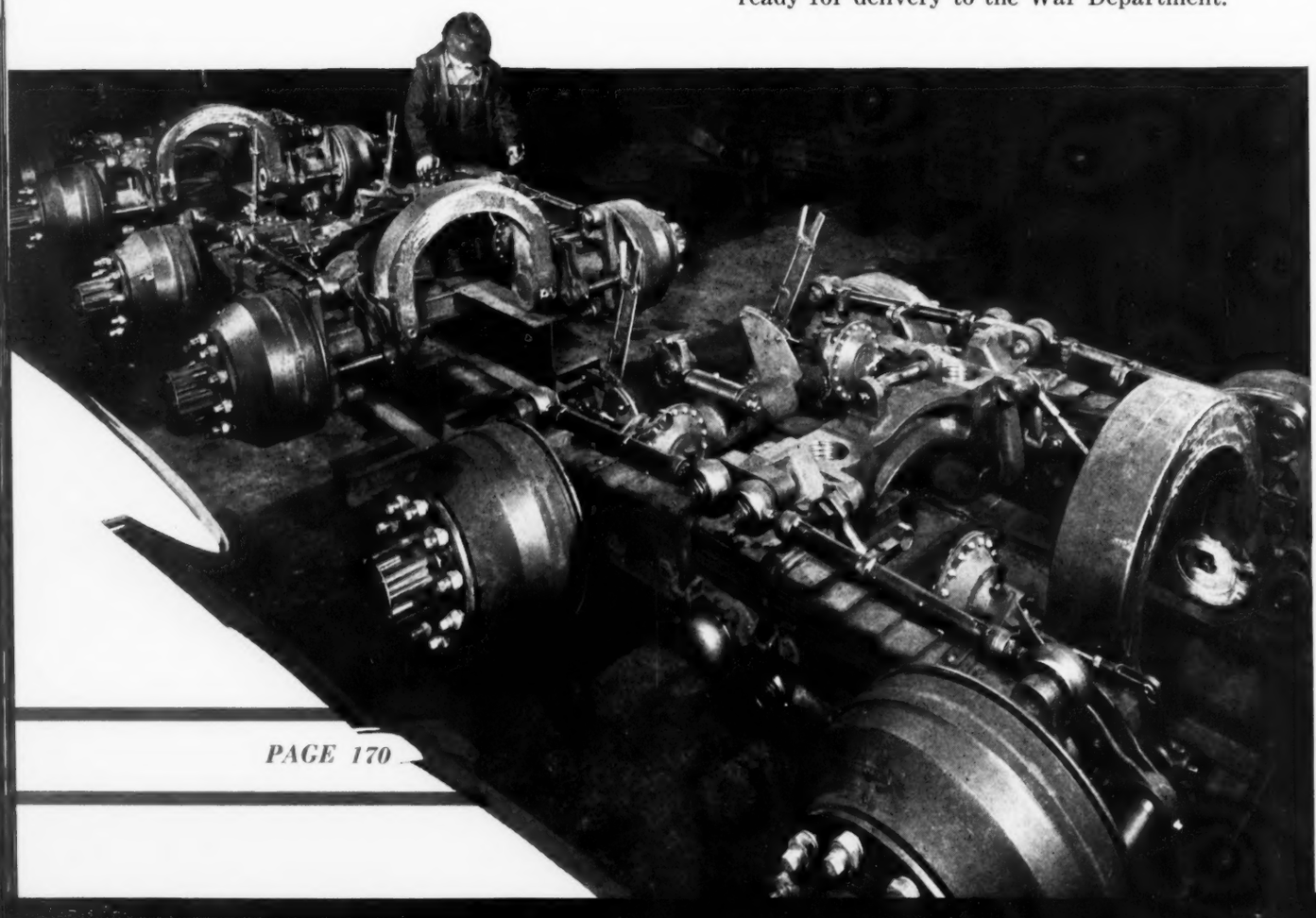
Fig. 10. Maxipres of 3000 Tons Capacity, Weighing 300,000 Pounds, Recently Installed in the Forge Shop

Rear-axle housings and various other long parts are straightened in the Oilgear 75-ton hydraulic press illustrated in Fig. 9. In the operation shown, this press is being employed to align the two ends of a round bar that has been forged with a U-bend in the middle. Prior to performing the operation, the part is placed between centers, as shown, and the amount of misalignment is determined by applying the dial indicator of a height gage against opposite ends of the work while revolving the work.

When the amount of misalignment has been determined, the centers that support the work are withdrawn, and the work is placed in the vees of supports seen on the press table. Pressure can then be applied for making the necessary corrections. When these bent bars reach the straightening press, the center lines through the ends are out of alignment as much as 0.400 inch. The ends are aligned within 0.040 inch before the parts are released for subsequent machining operations.

Another huge machine recently installed in the Timken-Detroit Axle plant is the Maxipres illustrated in Fig. 10. This press applies a force of 3000 tons, has a weight of 300,000 pounds, and is driven by a 100-H.P. motor. Machines of this type are designed primarily for the coining or finish-forming of forgings to accurate dimensions with the work semi-hot or cold.

Three bogies for 155-millimeter long-range artillery guns are shown in the illustration below, ready for delivery to the War Department.



Milling Square Lugs on Fuse Points at the Rate of 600 an Hour

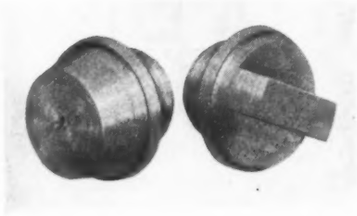


Fig. 1. Views of Fuse Point before and after Square Lug is Milled

The machining of square lugs on fuse points, as shown in the view at the right in Fig. 1, is accomplished at the high production rate of 480 to 600 pieces an hour on a "Rotomatic" eight-spindle vertical milling machine built by the Davis & Thompson Co., 6619 W. Mitchell St., Milwaukee, Wis. A full view of the machine is shown in Fig. 2, and a close-up view of the fixtures in Fig. 3.

Each of the eight spindles comprises a complete milling unit, and is supported by its fixture, as shown in the close-up view. The fuse point (which is shown before machining at the left in Fig. 1) is held in the jaws of the fixture, and the entire head of the fixture, with the piece, travels inward past the cutters, the feeding movement being effected by a cam located directly below the table. The cutters are spaced correctly to machine the lug on the fuse point to the required size. As shown in the view to the right in Fig. 1, the lug on the fuse point is finished on the top surface, as well as on the sides, by the complete milling unit.

The fixture is adjustable both for depth of cut and travel. Clamping is accomplished by hand, and the piece is automatically discharged when the fixture is opened. The fixtures or heads travel continuously around the machine column, the operator standing at one point to load and unload the work.

The machine is equipped with a coolant pump which is so arranged that the chips are washed out of the fixture and into the chip pan. The power equipment consists of one 25-H.P. motor having a speed of 1200 R.P.M., and one 2-H.P. motor having a speed of 1800 R.P.M. A friction clutch is employed to control the rotation of the fixtures, and a push-button control is provided for the spindles and coolant pump.

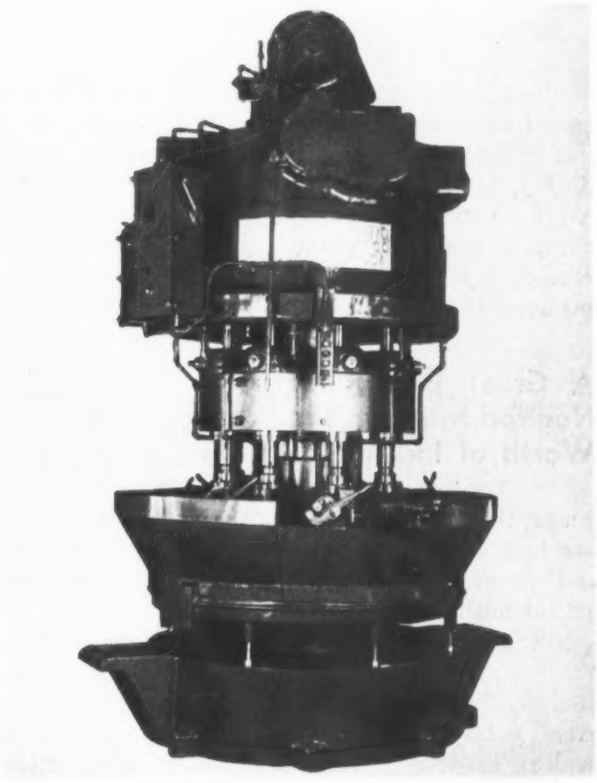


Fig. 2. "Rotomatic" Eight-spindle Vertical Milling Machine Equipped to Machine Square Lugs on Fuse Points at Rate of 600 an Hour

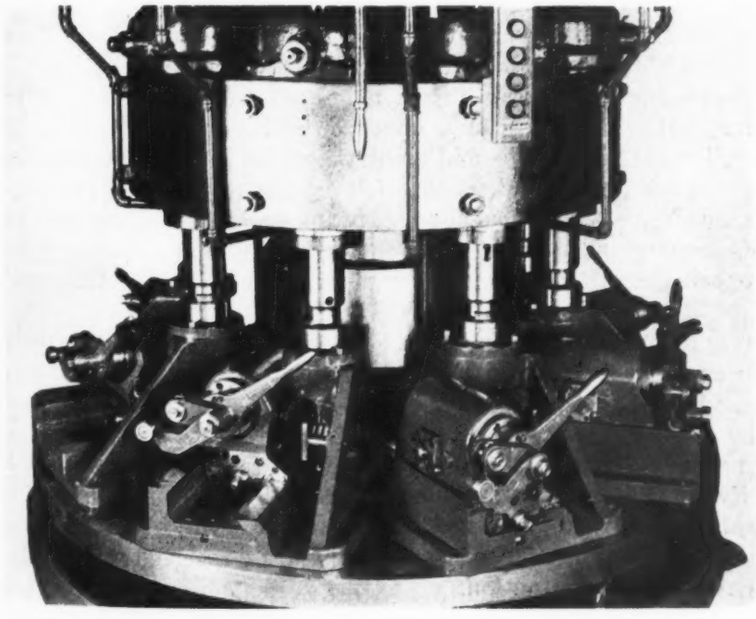


Fig. 3. Close-up View of Fixture Equipment of "Rotomatic" Shown in Fig. 2

* * *

Since many sources for high-carbon chromium steel have been cut off, there has been a trend toward the adoption of carburized nickel-molybdenum steel for bearing races. A high-carbon nickel-molybdenum steel also promises to effect a considerable improvement, as compared with materials now in common use for coil and leaf springs.

EDITORIAL COMMENT

Many Americans need to gain a new understanding of and a new respect for industry. As pointed out in the publication *United Effort*, American industry, for some time to come, will be expected to exert its maximum energies in two directions: First, it must provide for peacetime needs; and second, it must provide all the requirements for insuring this nation against ruthless attack. Industry cannot carry this double load if it is met with the same apathy, the same lack of understanding, not to say contempt, that has been its experience in recent years—a lack of understanding that has been fostered and fanned into flame, unfortunately, by high official authority.

A Great Emergency Needed to Prove the Worth of Industry

New emergencies have made an old truth stand out in a new light; the truth that national security and well-being, in peaceful times as well as in a great national crisis, necessarily depend upon a healthy industry, guided by men of imagination, ability, and willingness to work.

It is a tragic fact that it should take a war involving nearly the whole world to make this truth apparent to the great mass of Americans.

Whenever mechanical men are engaged in conversation, it is almost certain that some one will reach for a pencil and a piece of paper (or the tablecloth will do) in order to express his thoughts graphically. The sketch language is very valuable when there is need for a graphical explanation; but too often mechanical men resort to sketches when a clear thought, clearly expressed in words, would be equally effective.

Sketch Language is All Right—in Its Place

To be able to use simple sketches to express ideas is a valuable asset; but so is the ability to express ideas and to explain a proposition clearly and simply in words. Many an idea suggested by a subordinate to his chief has been turned down because it was not explained with sufficient clarity to be correctly understood. The ability to explain an idea clearly and concisely is often as important as the idea itself, because if the proposal is rejected due to inability to make it understood, the idea is valueless in practice, since it brings no results.

In explaining mechanical ideas, sketches are most useful—sometimes absolutely necessary; but the habit of always making a sketch to express even the simplest idea is one that mechanical men should be careful *not* to cultivate.

Most people believe that something is wrong, because American industry, which can turn out automobiles, washing machines, electric motors, and hundreds of other articles at a tremendous speed by mass production methods, is so slow in getting ready to turn out war material. Mr. Kettering, president of the General Motors Research Corporation, makes an interesting comment on this point. He points out that by mass production methods it is possible to produce all kinds of objects in a minimum time per unit; but this does not mean that the necessary equipment for this mass production can be provided in a very short time. The more highly developed the mass production methods are, the more special machinery, jigs, fixtures, tools, and gages are required, and the longer it takes to get ready to start to produce in great quantities.

The Problems of Mass Production are Not Well Understood

As an example, Mr. Kettering points to the methods of producing a modern newspaper. Mass production in printing has made it possible for a newspaper to get a bulletin off a telegraph wire and distribute hundreds of thousands of copies of it in black and white within an hour; but the printing plant, with all its varied equipment of typesetting machines, printing presses, etc., would take at least five years to design and build from scratch, if there were no equipment available for this type of mass production.

There are two aspects of mass production—speed in the long run, and time-consuming complications, adjustments, and tooling-up methods in the indispensable period for making ready for mass production. The trouble is that today the efficiency of mass production has been played up in the public press, but the complications involved in making ready for mass production have received practically no attention.

The Detroit Machine and Tool Progress Exhibition

AS MACHINERY is going to press, the Machine and Tool Progress Exhibition of the American Society of Tool Engineers is still in progress in the Detroit Convention Hall. This exhibition far exceeds any previous exhibits held under the auspices of the Society, in regard both to the amount of space occupied by exhibitors and the variety and outstanding character of the exhibits. More than 250 exhibitors are taking part in the exposition.

One of the reasons for the great amount of space occupied by this exhibition was the rapidly growing appreciation, within the last few weeks preceding the opening of the exhibition, of the important part it played in the Defense Program. The exhibition, held in conjunction with the annual convention of the Tool Engineers, is closely keyed to the Nation's defense preparations; the technical sessions, as well as the exhibits themselves, concentrate on bringing the latest information and developments in tools and machines to the attention of executives and engineers now engaged in tooling up for defense production. At the present writing, indications are that over 30,000 executives, engineers, production managers, and others vitally interested in the mechanical industries will register for the exhibition and the technical sessions.

The exhibits cover almost every branch of the shop equipment, tool, and accessory industries. Among the more prominent of the groups of exhibits may be mentioned the latest types of cutting tools shown by practically all the leading tool manufacturers in the country; optical and mechanical inspection devices for all types of testing, checking, and inspection; welding equipment; portable electric tools; machine attachments and accessories; cutting lubricants; drafting-room equipment, including the newest types of blueprinting machines; riveting machinery; and many types of machine tools, especially those of a somewhat specialized character.

One of the outstanding events in connection with the exhibition was the preview and the preview dinner held on Monday, March 24, the day before the formal opening of the show. The exhibition was open to the public from March 25 to 29. This preview was sponsored by a group of leading industrialists, including K. T. Keller, president, Chrysler Corporation; Edsel Ford, president, Ford Motor Co.; Charles E. Wilson, president, General Motors Corporation; C. W. Avery, president, Murray Corporation; and A. Berit, president, Hudson Motor Car Co. The dinner was attended by an invited group of the country's prominent executives, engineers, and educators, as well as by Army and Navy officers engaged in National Defense preparations.

The principal speaker at the dinner was Major-General Charles M. Wesson, Chief of Ordnance of the United States Army, who spoke on "The Job Facing Industry in Arming This Nation." The toastmaster was L. Clayton Hill, manufacturing manager of the Murray Corporation, who was introduced by A. H. d'Arcambal, consulting metallurgist of the Pratt & Whitney Co. and president of the American Society of Tool Engineers.

The technical sessions dealt chiefly with subjects having a direct bearing upon the present armament program. Each session was devoted to some specific part of the program. The evening session held on Tuesday, March 25, dealt with aircraft production. A paper on "Aircraft Engine Design and Production" was presented by C. W. VanRanst, chief aircraft engineer of the Ford Motor Co. Another paper on "Tooling for Fuselage Production," prepared jointly by the Lockheed and Vultee organizations, was presented by Louis Biehler, assistant chief tool designer of Vultee Aircraft, Inc.

Naval ordnance production was the subject of the meeting held Wednesday evening, March 26. At this meeting, Joseph A. Davies, chief planner and estimator at the Naval Gun Factory, Washington, D. C., spoke on "Problems of Production of Naval Ordnance Units." The session held Thursday evening, March 27, dealt with industrial and trade education. P. W. Brown, assistant works manager of the Wright Aeronautical Corporation, spoke on "Industry's Need for Skilled Help." Carl A. Gray, president of the Grenby Mfg. Co., spoke on "How Connecticut Solved the Industrial Training Problem," while J. R. Weaver, manager of the Louisville Ordnance Division of the Westinghouse Electric & Mfg. Co., described the work that the American Society of Tool Engineers is doing in furthering the work of industrial training.

The annual dinner of the Society, held Friday night, March 28, was one of the highlights of the convention. At this dinner L. R. Pennington, administrative assistant to J. Edgar Hoover, director of the Federal Bureau of Investigation, spoke on "How to Prevent Sabotage in our National Defense Program." This address contained much both of interest and value to every industrial executive in these serious times.

In connection with the meeting of the Society, a number of plant inspection tours had been arranged to leading manufacturing plants in Detroit.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Irregular, Intermittent, Rotary-Motion Mechanism

By L. KASPER

The design of an irregular, intermittent, rotary-motion mechanism which is used on a machine for producing a twisted wire product is shown in the accompanying illustration. With this mechanism, the driven shaft *C* is given a complete revolution during a half revolution of the driving shaft *A*; and during the second half revolution of the driving shaft, the driven shaft remains stationary, except for a slight change of position.

Referring to Fig. 1, driving shaft *A* carries gear *B*, which transmits its motion through gear *D* to shaft *C*. Gear *D* has a full complement of teeth, while gear *B*, which is of a pitch diameter equal to twice the pitch diameter of gear *D*, has only a sufficient number of teeth to produce a full revolution of gear *D*. Gear *B* carries an internal cam *E*, the groove of which receives roller *F* mounted on gear *D*.

In Fig. 1, gear *D* is shown beginning its rest period. The last tooth in the toothed section of gear *B* is just leaving its mating tooth in gear *D*, and roller *F* has entered the groove in cam *E*, the leading end of which is shaped to suit the path in which roller *F* travels while gear *D* is still being driven by gear *B*. From this point, the groove in cam *E* is formed to a true radius with the center of shaft *A*, which permits cam *E* to continue its motion without imparting any motion to gear *D*. It will be noted that, during the rest period of gear *D*, roller *F* is off the center line between shafts *A* and *C*, which locks gear *D* in position, preventing accidental rotation.

As the rise in cam *E* reaches roller *F*, the effect is to give a slight rotative motion to gear *D* in its original direction. Gear *D* then remains stationary

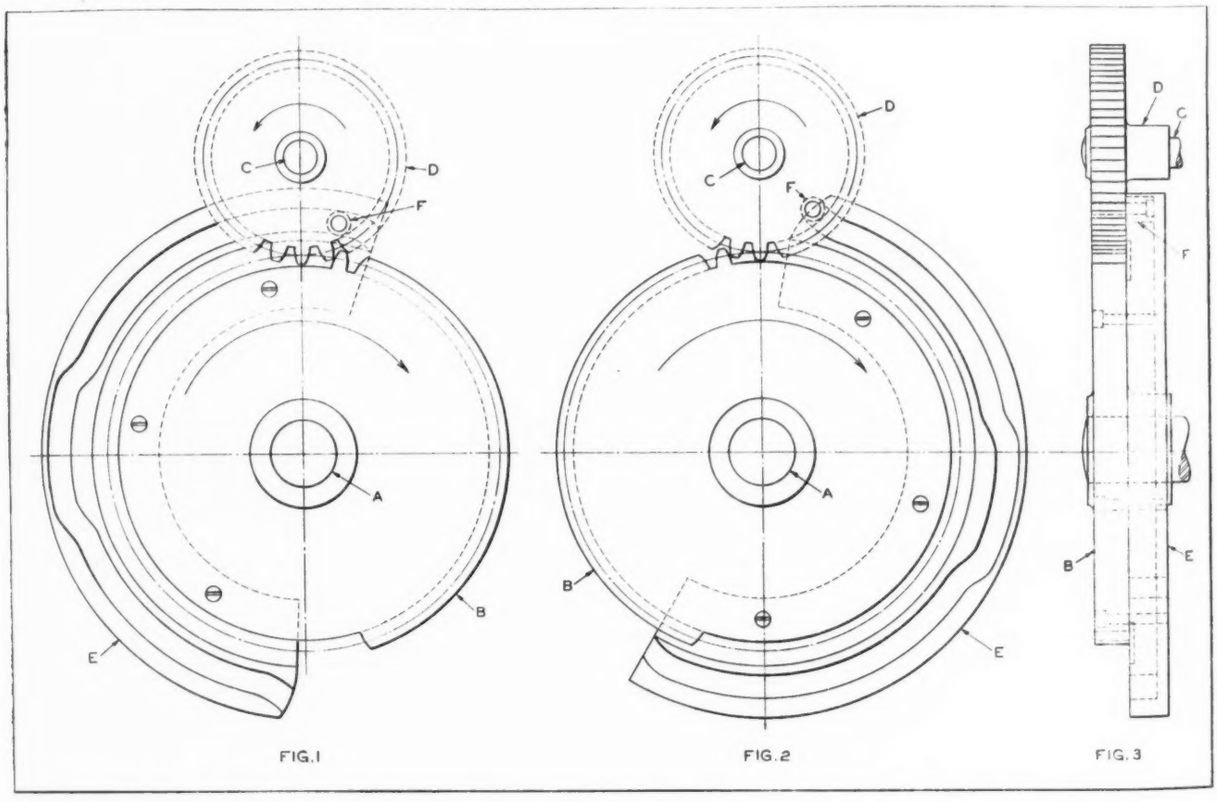


Fig. 1. Irregular, Intermittent, Rotary-motion Mechanism with Driven Gear D about to Begin Dwell
Fig. 2. Driven Gear D about to Begin Rotation. Fig. 3. End View of Mechanism Shown in Fig. 2

in its changed position for a short time, returning to its original rest position as the fall of cam *E* passes roller *F*. Gear *D* now remains stationary for the remainder of the rest period.

In Fig. 2, gear *D* is shown just about to start its rotation, the first tooth of the toothed section in gear *B* engaging its mating tooth in gear *D*. Before these teeth become engaged, the rise at the end of cam *E* produces a gradual partial rotation of gear *D* corresponding to that which would be given it by one tooth. In this manner, gear *D* is already in motion when the teeth engage, thus eliminating shock on the first tooth. Gear *D* then makes a complete revolution before roller *F* again enters the groove in cam *E*. An end view of the assembled mechanism is shown in Fig. 3.

Mechanism for Operating Automatic Hoisting and Stacking Tongs

By C. W. HINMAN

The problem of providing more floor space to meet the requirements of companies engaged in armament work has been solved in some cases by placing manufactured parts and partial assemblies into labeled barrels, boxes, or drums, and then piling up these packed containers to a height of several tiers. While this has been found a satisfactory method of obtaining extra floor space, it requires the use of a crane and good material-handling equipment. The quick-action automatic tongs here illustrated, with operating mechanism designed as shown, were constructed especially for use in performing this work.

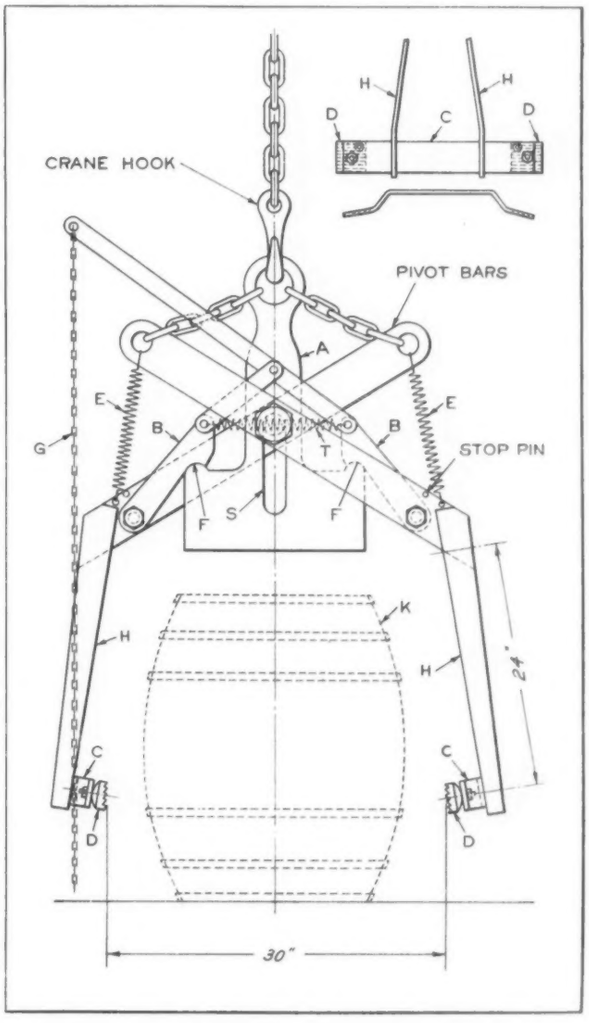
Referring to the illustration, center bar *A* and latches *B* are flame-cut from rough structural steel 3/4 inch thick. The center bar is purposely made heavy, so that it will descend by gravity when released. The four bars *H* are welded to the sides of the pivot bars, and the two lower cross-bars *C* are welded across the lower ends of bars *H*, as shown in the upper right-hand corner. The toothed gripping jaws *D*, four in number, are designed to obtain an equalizing grip on the container to be lifted. This feature permits the jaws to clamp and lift either round barrels, or containers or boxes having flat sides.

When the tongs are open, latches *B* are hooked over the two arc-shaped sections *F* that form part of center bar *A*. The tongs are then placed around the object to be lifted. A slight pull of the hand-chain *G* opens the latches and frees bars *H* and jaws *D*, so that they instantly approach each other and firmly grip any object to be handled, such as barrel *K*. The load is then hoisted by the crane hook and placed in the desired location.

When the crane hook is lowered, the center bar descends by gravity, as provided for by the vertical clearance slot *S* cut through its center. When it has descended far enough, latch hooks *B* are caused to snap together over the arc-shaped sections *F* through the pulling action of spring *T* attached to their ends. When the crane hook is again raised, the latches cause the jaws to open so that the tongs are ready to be lowered for lifting the next container.

In removing packages from the tops of the stacked tiers, the operation of the device is simply reversed. The two light-tension springs *E* serve to prevent the jaws from collapsing or coming entirely together.

In building this equipment, no precision fits are necessary. The center block has a clearance of about 1/8 inch between the pivot bars. A separator bushing through the long vertical slot and around the pivot bolt has a similar clearance. These tongs grip securely anything that can be placed between them. Although the distance between the open jaws *D* is indicated as 30 inches in the illustration, this opening can be adjusted by providing several holes for the latch fulcrum bolts at different positions.



Hoisting and Stacking Tongs with Mechanism for Gripping Barrel or Box when Control Chain G is Pulled and which Releases Load when Crane Hook is Lowered

Heyman Semi-Automatic Feeding Machine for Presses

A semi-automatic feeding machine that can be applied to any ordinary type of press has been brought out by the Heyman Co., 157 Chambers St., New York City. The chief features of this feeding machine are that it provides complete safety for the press operator and increases production. A most important point in the design is that these advantages are obtained without the need for scrapping the dies that are in use on the press. In many cases, no changes at all need be made in the dies, while in others, only minor changes are required. The machine is designed especially for runs between 3000 and 500,000 pieces.

As applied to the press, the feeding machine is not merely an attachment, nor is it chiefly a safety device. It is essentially a semi-automatic production feeding machine, operated by an electric motor, that, in turn, operates the press. The pace of the operator is set by the speed of the feeding machine; but both the feeding machine and the press are constantly under the control of the operator, whose job it is merely to place the parts to be operated upon in position on a feed dial, from which an arm on the machine picks up the part and moves it into position in the die. This means that the operator's hand never need be in any position of danger.

Ordinary dial or slide feeds safeguard the operator's hands in a similar way, but such feeds usually require a complete change in the tooling set-up and the replacement of old dies, because, since the dial passes over the die, the latter must be especially made to operate in conjunction with the dial.

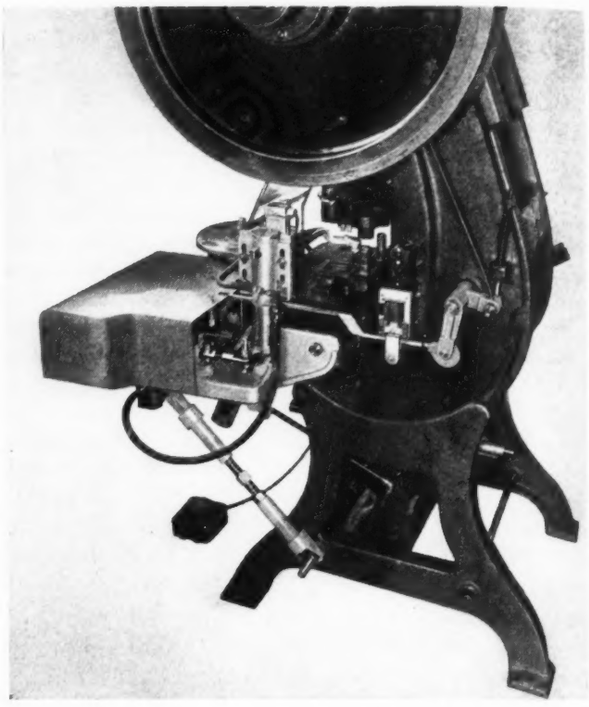


Fig. 1. Heyman Semi-automatic Feeding Machine Applied to an Inclinable Press

When very large quantities are required, the operator's safety may be assured by the use of a multiple plunger press and progressive dies; but frequently the quantities needed are not large enough to warrant the expense of this kind of production equipment. The feeding machine here illustrated becomes especially applicable in such cases, because it is readily adjustable in any direction to feed work to dies of any height or type ordinarily encountered.

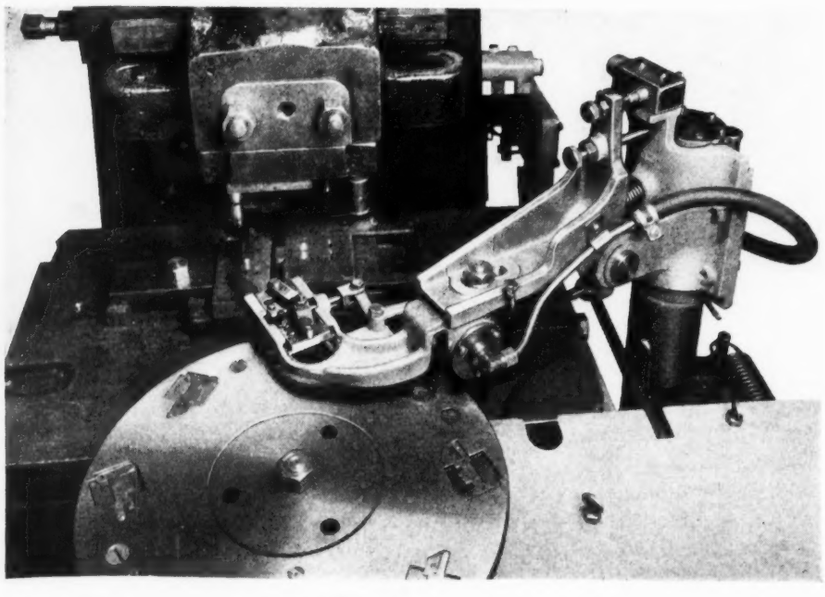


Fig. 2. Close-up View of Feeding Machine Showing Dial and Transfer Arm

As will be seen from the illustrations, this feeding machine differs from the ordinary dial feed in that the dial is located away from the die. In Fig. 2, for example, the pick-up arm must travel 7 inches in order to deposit the blank on the die.

The machine is made with two types of transfer arms—a mechanical pick-up arm and a vacuum arm. The former is shown in Fig. 2. In this arm, two jaws are drawn together

by means of a toggle which, in turn, is operated through a vacuum cylinder. The vacuum arm, because it has no moving parts, is used preferably where the part can be lifted most easily by a flat surface. Three sizes of nozzles are furnished which can be shaped to suit the work to be lifted.

One of the most costly press operations is the type in which the piece is so small that it must be placed in the press with pliers or tweezers. On work of that kind, the new feeding machine has proved an aid in producing twice as much work in a given time as was formerly possible. In subassembly press work, considerable increase in production is also obtained because of the operator's feeling of safety when using the feeding machine, coupled with the fact that he can work where the light is good, away from the die.

It is apparent from what has been said that, after the jaws or vacuum nozzle have picked up the blank from its position on the index-plate, the pick-up arm rises vertically and is carried across to the die. Then it descends again and the blank is released when it practically touches the die.

The design prevents two blanks from being deposited or the placing of a blank over a piece that has not been ejected after the previous stroke. To prevent injury to either the die or the press from such an occurrence, the vacuum arm is hinged near the post and held in a set position by a spring. If an obstruction is present, the arm will not be able to descend its full distance, and through a limit switch and a solenoid located on the side of the press, the trip is disengaged and the press stopped. When everything is in order again, a slight touch on the reset button of the limit switch starts the machine. The motion of the arm carrying the blank to the die is slow, whereas the return of the empty arm from the die is rapid.

The indexing table is driven by a ratchet on a camshaft which, in turn, is rotated at a predetermined speed by a separate electric motor. The index table moves comparatively slowly, with the result that no positive stops are needed to keep the table from over-running its position; a band brake is all that is necessary. This is an important feature. When a press operates at, say, 125 strokes per minute, the ordinary dial feed must move forward rapidly, whereas with the arrangement in the present feeding machine, much more time is obviously permissible from station to station, as the time required for the entire stroke may be utilized.

The machine is controlled by a foot-switch which keeps the motor in either constant or intermittent rotation. The tripping of the press is controlled by the feeding machine through a cam. All the operator has to do is to sit in front of the machine and place the blanks in position as the table is indexed around. When the blank comes opposite the die, it is transferred.

The safety guard in front of the press, shown in Fig. 1, has a point of special interest. The left end of this guard rests against a limit switch, which is placed in series with the current going to the solenoid previously mentioned. Hence, when the guard is removed it is impossible to start the press.

The feeding machine is furnished completely assembled as a separate unit, fully wired. All that is necessary is to attach the lead of the switch. Under normal conditions, the entire machine can be attached to a power press in less than ten man-hours. A small vacuum pump operated by a 1/6-H.P. motor is part of the equipment. The vacuum used averages 22 inches of mercury, sufficient to lift quite heavy pieces and carry them over to the die without shifting.

* * *

General Electric Employes Awarded for Outstanding Achievements

The Charles A. Coffin Foundation awards for this year have been made by the General Electric Co., Schenectady, N. Y., to twenty-five employes in recognition of outstanding contributions made last year to the progress of the company and to the electrical arts. The awards were made for twenty-one distinctive accomplishments, four of them being joint awards to two employes. Of those who received awards, eleven were factory workers; ten, engineers; three, administrative or clerical employes; and one, a salesman. Since the Foundation was established, eighteen years ago, more than five hundred employes have been recipients of these annual awards.

An outstanding award was made this year to Horace S. Hubbard, of the company's Pittsfield, Mass., Works, for the development and design of a 1,400,000-volt direct-current generator for the National Bureau of Standards in Washington. This generator provides power for a 1,400,000-volt X-ray tube, made by the General Electric Co. and in daily use at the Bureau of Standards for tests and research on X-ray problems. Mr. Hubbard has been with the General Electric Co. for twenty years; he is a graduate of Pratt Institute, Brooklyn, N. Y.

* * *

Railroad Equipment Orders Highest in Fifteen Years

Early this year, the railroads of the United States had more new freight cars on order than at any time in the last fifteen years. New freight cars on order on February 1 totaled 41,600. At that time, the railroads also had 238 new locomotives on order, of which 120 were steam and 118 electric and Diesel. During the past year, the railroads added 32 light-weight, streamline trains, with a total of 203 cars, to the 66 trains of that type that were in operation previous to 1940. Nearly 7000 passenger coaches are now air-conditioned, in addition to over 5000 Pullman cars so equipped.

Simplified Adjustable-Speed Motor Drive

By S. H. HANVILLE, Motor Engineer
Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

The high-torque characteristics of a direct-current series motor are combined with the flat-speed characteristics of a shunt machine in a new series adjustable-speed drive developed by the Westinghouse Electric & Mfg. Co. The new drive has a continuously variable speed range of 10 to 1. It uses the variable-voltage principle, but employs a series circuit that requires no exciter; consequently both control and wiring are simplified.

Basically, this drive, as shown in Fig. 1, consists of a squirrel-cage induction motor operating from an alternating-current source and mounted in the same frame with a series direct-current generator which supplies operating voltage for a series motor connected to the driven machine. For speed control, there is a low-resistance field rheostat. The only additional equipment required is a starter and push-button for the squirrel-cage motor. Where alternating-current power is not available, the generator can be belted or connected directly to any suitable prime mover, such as a Diesel or gas engine, or a lineshaft.

Operation of the drive is similar in principle to that of the conventional variable-voltage drive. It is started simply by pushing the "start" button. This closes the starter contactor, the motor-generator set comes up to speed, and the direct-current driving motor starts. Such smooth starting provides a magnetic cushion against shock to gears or to the driven machine. With a constant load on the driving motor, the speed of that motor can be changed by varying the resistance of the field rheostat, which varies the voltage output of the series generator. Once the desired speed has been set, any tendency for the load to increase or decrease causes a corresponding increase or decrease in the field current, because the fields of motor and generator are in series. This raises or lowers the generator voltage, partially compensating for IR drop and armature reaction, thus tending to maintain a constant speed.

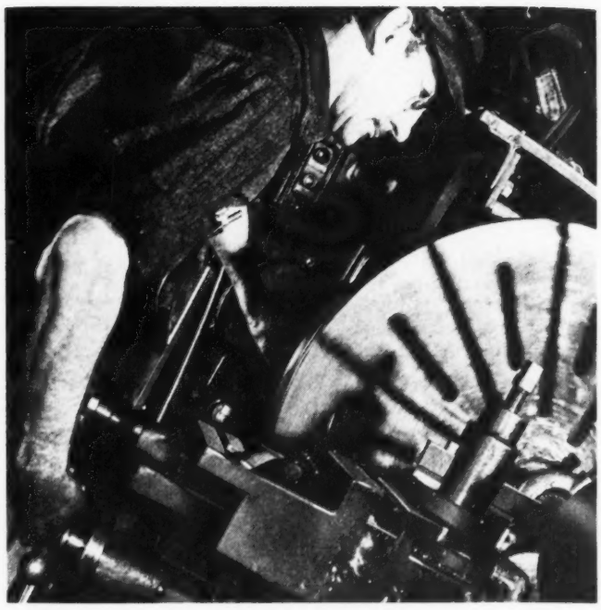


Fig. 2. One Control Operates Lathe Equipped with New Adjustable-speed Drive

If the application requires it, dynamic braking and "inching" can be incorporated in the circuit without using an external braking resistor. Braking is accomplished by a so-called "self-energizing braking field," which is no more than a separate series field wound on the same shell as the series field coil of the motor. Besides making external braking resistors unnecessary, the field resistance limits the braking current to a safe value.

When dynamic braking is employed, the addition of a momentary-contact push-button to the regular start-stop push-button station provides an "inching" control. The "inching" button is electrically interlocked with the field rheostat, so that the drive will "inch" only when the rheostat is set for slow speed. This prevents strain on both the driving motor and the driven machine.

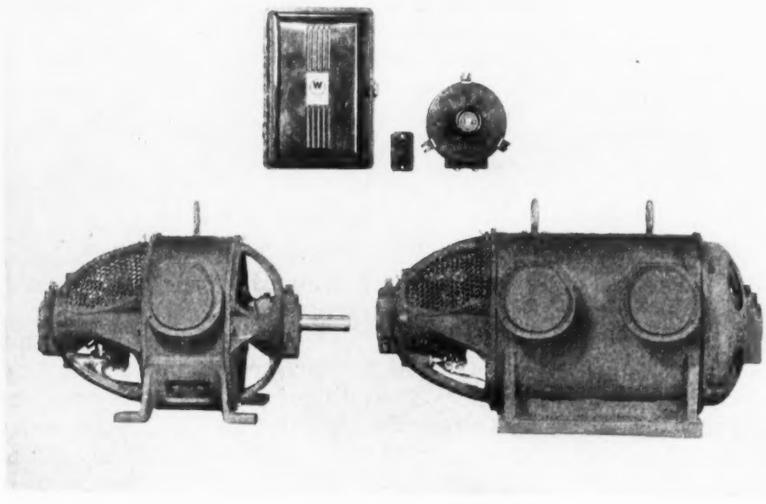


Fig. 1. Units of Westinghouse Simplified Adjustable-speed Alternating-current Drive, which Requires No Exciter

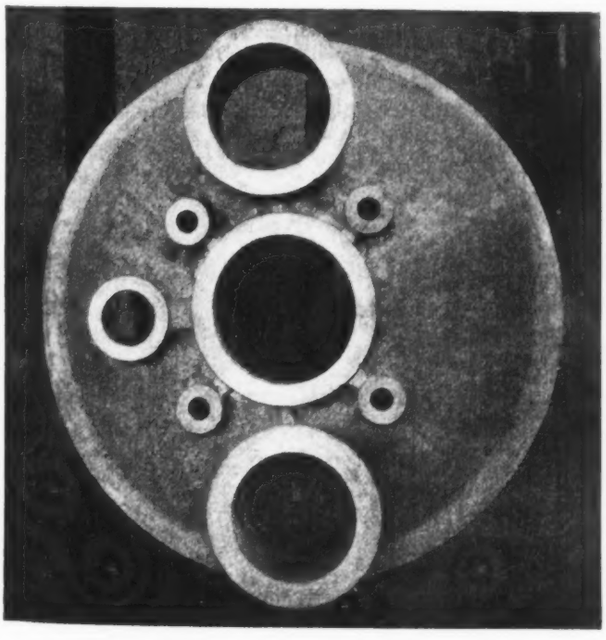
Two Bronze Alloys for Worm-Gear Application

Abstract of a Paper Presented by B. A. Miller of the Cramp Brass and Iron Foundries Co., Eddystone, Pa., before the American Gear Manufacturers Association

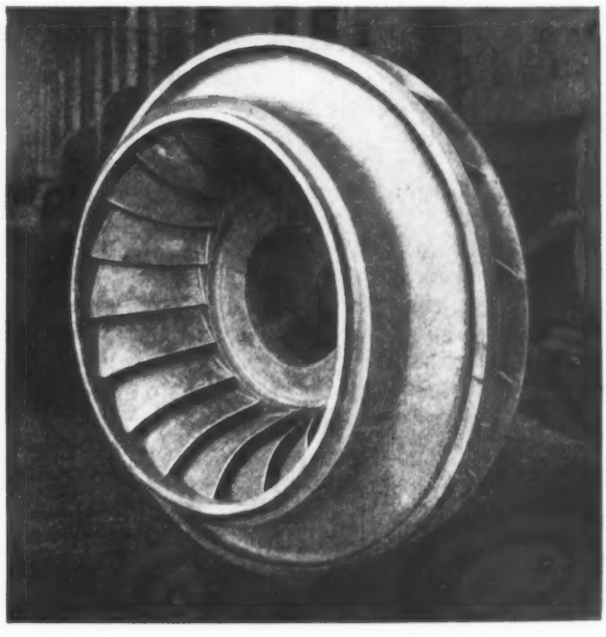
TO be suitable for the construction of the gear or bearing member of a worm-gear combination, a material must have good bearing properties and be strong and ductile. The high-tin bronzes containing 10 per cent or more of tin, often modified by the addition of small percentages of nickel, phosphorus or lead, have been used successfully for years, but metallurgical research in the laboratories of the International Nickel Co. has led to the development of an even stronger alloy, a heat-treatable nickel-tin bronze. This bronze, which has been produced in castings weighing up to 3500 pounds, possesses a number of interesting characteristics. It appears to have application in the steel industry for high-speed, heavy-duty gears, particularly those on screw-downs, which are subject to considerable shock.

This alloy must be produced under strict metallurgical control, and is basically a copper-tin bronze in which various percentages of tin are replaced with nickel. The percentages of tin and nickel depend upon the service requirements, and the tensile properties depend upon the composition and hardening treatment. One alloy that has proved to possess good foundry characteristics and strength properties, and is also of moderate cost, has the following composition: 5 per cent tin, 5 per cent nickel, under 0.01 per cent lead (where the alloy is to be age-hardened), and the balance copper, with up to about 2 per cent zinc. Lead may be present in the alloy if it is to be used "as cast," but if it is to be heat-treated, the exclusion of lead is essential, as it impairs the age-hardening behavior and lowers the ductility and other properties. For this reason, virgin metals are employed in producing castings to be heat-treated, and contamination by other alloys is scrupulously avoided. Silicon also retards the aging, and should be kept low. The deoxidizer employed is left to the discretion of the foundry, for the reason that the type and amount required are more or less related to the melting conditions in the foundry producing the alloy.

In Table 1 the tensile properties of the 88-5-5-2 alloy "as cast" are given, together with specification values for S A E-65 alloy. As will be noted, the minimum tensile properties of this nickel bronze are much above the minimum specification values for the S A E alloy.



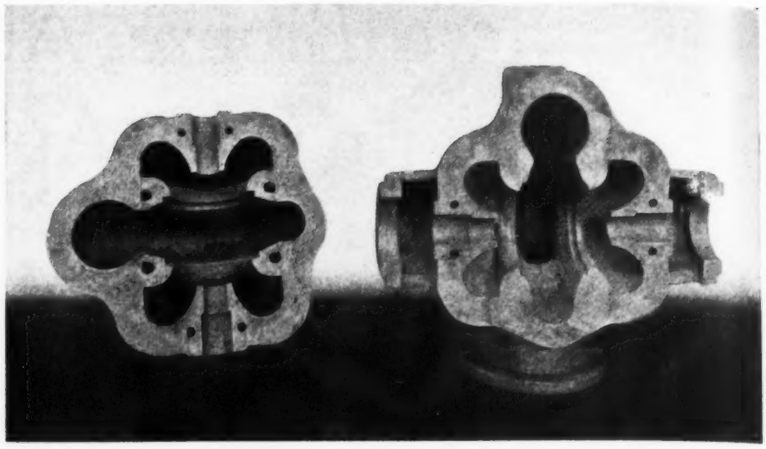
A Cover Made from P. M. G. Metal. Here the Acid-resisting Properties are of Value



Turbine Runner Made from P. M. G. Metal; here Corrosion and Erosion Resistance are of Value

This alloy responds to heat-treatment, and when so treated, develops even higher physical properties. The heat-treatment is typical of age-hardening alloys, comprising a solution treatment (homogenizing anneal) at elevated temperatures which leaves the metal, after quenching, in a dead soft condition; then follows an aging treatment at 500 to 600 degrees F. for several hours, which causes the alloy to harden.

Table 2 gives a specific example of the properties obtained "as cast," and after the two steps in the heat-treating operation. Table 3 gives the properties obtained by complete heat-treatment.



Upper and Lower Half of a P. M. G. Metal Pump Casing

With proper foundry practice and metallurgical control, castings of this analysis can be obtained without much difficulty. It should be noted, however, that the ductility after the age-hardening treatment will not attain normal values unless a perfectly sound casting is obtained. Therefore, if the test bars attached to the gear casting are tested after the age-hardening treatment and show that the required physical properties have been obtained, it will be evident that melting, molding technique, and composition were correct. With a retarded cooling rate, more desirable physical properties are developed in this alloy; consequently, chills are not employed because of the increased cooling rate which they produce. This metal is suggested for heavy-duty applications with contact speeds in excess of 300 feet per minute.

Table 1. Properties of Nickel-Tin Bronze "As Cast"

Physical Property	Copper-Tin-Nickel-Zinc Alloy	S A E-65 Specification, Minimum
Proportional Limit, Pounds per Square Inch	16,000	
Yield Point, Pounds per Square Inch	25,000	20,000
Tensile Strength, Pounds per Square Inch	50,000	35,000
Elongation in 2 Inches, Per Cent	44	10
Reduction of Area, Per Cent	42.8	
Modulus of Elasticity	16,000,000	

In view of the possibility that the tin market may be temporarily interrupted or curtailed to some extent, a substitute metal should be immediately available for what we shall refer to as run-of-mine gears—those now being made of copper-tin or copper-tin-nickel alloys. Such an alloy is manufactured under the trade name of P.M.G. Metal. It contains no tin. This metal is alloyed by adding silicon and iron, in the form of a hardener, to molten copper. This hardener is obtained in the form of slabs having approximately 20 per cent silicon, 8 per cent iron, and the balance copper.

As in the case of heat-treated nickel bronze, this metal must be produced under strict metallurgical control. The selection of a deoxidizer is left to the discretion of the foundry. Experience will show which is the most suitable for the melting conditions involved. The metal can be melted successfully in coke, oil, or electric furnaces.

The metal is supplied in a number of grades, and for gear purposes is generally of the following chemical analysis: Silicon, 3 to 5 per cent; iron, 1 to 3 per cent; and the balance copper. Zinc has been employed in varying percentages in P.M.G. Metal, but is not recommended in the alloy for gears. The chemical analysis and physical properties of the grade suggested for gear purposes are given in Table 4. Heat-treatment is not necessary with this metal.

Gears constructed of both the foregoing grades have been in successful operation for a considerable period of time. It has been demonstrated in the field that this metal is less susceptible to shock than copper-tin bronzes.

Table 2. Properties of Nickel-Tin Bronze "As Cast" and after Two Heat-Treating Steps

Material	Yield Point, Pounds per Square Inch	Tensile Strength, Pounds per Square Inch	Modulus of Elasticity	Elongation in 2 Inches, Per Cent	Reduction of Area, Per Cent	Brinell Hardness
As Cast	24,000	49,500	16,000,000	46	41.6	95
Annealed and Quenched	18,750	42,000	12,000,000	52	53.2	80
Age-Hardened	66,000	82,000	17,000,000	16	22.0	190

Table 3. Properties of Nickel-Tin Bronze Obtained by Heat-Treatment

Tensile Strength, Pounds per Square Inch	70,000 to 90,000
Yield Point, Pounds per Square Inch	40,000 to 75,000
Proportional Limit, Pounds per Square Inch	30,000 to 60,000
Elongation in 2 Inches, Per Cent	25 to 5
Brinell Hardness	140 to 220

This alloy must be melted under a good covering or flux, and subsequent treatment involves the use of a good degasifier for the removal of gases and oxides before pouring. The treatment of the metal in the crucible is as important as the conditions under which it is poured, and in order to assure proper physical properties and grain structure, this procedure must be followed carefully. Owing to the excessive fluidity of this alloy, the pouring temperatures between large and small sections do not vary appreciably. A recommended pouring temperature is between 1980 and 2100 degrees F. This alloy has a very narrow freezing range, which is conducive to producing a sound casting when proper gates and risers are employed. As with heat-treated nickel-bronze, a retarded cooling rate is essential. Chills, therefore, are not used.

* * *

Hard-faced valve seats in bus engines have been found to be in excellent condition after 110,000 miles of service, as compared with from 10,000 to 20,000 miles for regular steel surfaces.

Table 4. Chemical Analysis and Physical Properties of P.M.G. Metal

Chemical Analysis		
	Grade 99	Grade 103
Silicon	3.50 to 4.00	4.00 to 4.25
Iron	1.25 to 1.75	1.75 to 2.25
Copper	Balance	Balance
Physical Properties		
	Grade 99	Grade 103
Tensile Strength, Pounds per Square Inch	45,000 to 50,000	50,000 to 55,000
Yield Strength, Pounds per Square Inch	19,000 to 22,000	20,000 to 23,000
Proportional Limit, Pounds per Square Inch	10,500	10,000
Elongation in 2 Inches, Per Cent	19 to 23	15 to 20
Reduction in Area, Per Cent	20 to 25	15 to 20
Modulus of Elasticity	15,000,000	16,000,000
Electrical Conductivity	4.9	4.8
Brinell Hardness	100 to 125	115 to 140

Saving Time in Removal of Burrs

Removing burrs from machine parts is often a troublesome and expensive operation. Usually it is performed by hand grinding, filing, or scraping. In one plant producing small parts in automatic screw machines, the burring problem became so serious that the entire production schedule was thrown out of balance. It was suggested that the burrs might be removed by blasting with a fine metallic grit in a Wheelabrator Tumblast, which is an airless blast cleaning machine built by the American Foundry Equipment Co., Mishawaka, Ind. This machine was used in this plant in another department. The idea was tried and found successful. The burrs were removed without injuring the machine part itself.

In another instance, a manufacturer was finishing a large order of small steel shafts for a customer who demanded an exceptionally clean finish. Trouble arose from a burr due to notching one end of the shaft. To grind off the burr was a costly and time-consuming operation. The manufacturer was faced with the loss of his entire profit on the job unless the burrs could be removed faster and at less expense. Again, a Wheelabrator Tumblast was installed to do the job. The manufacturer reports that what he saved on this job alone paid for his investment in the equipment, and it is now being used for other cleaning operations.

* * *

Spirally Wound Transparent Acetate Tubing for Electrical Purposes

A self-supporting, spirally-wound, transparent acetate tube has been developed by the Precision Paper Tube Co., 2033 Charleston St., Chicago, Ill., which, due to its dielectric properties, is recommended for many high-frequency and electronic applications in the radio and electrical industries. It is also adapted for certain types and applications of low-amperage cartridge fuses. Since the tube is transparent, not easily broken, and has a low moisture absorption rate, it is suitable for use in liquid gages where temperatures do not exceed 180 degrees F. Being preformed, it is stated that the tube will not shrink, thereby overcoming one of the difficulties present in extruded acetate tubes.

* * *

The American Library Association, 520 N. Michigan Ave., Chicago, Ill., has published a pamphlet known as "The Shop's Library—Books Useful for Training," listing a great number of books especially suitable for machine shop training. The Library Association has also published a pamphlet entitled "Why Industrial Training Needs Books," which outlines briefly a few fundamental reasons why books are necessary in adequate machine shop training.

MATERIALS OF INDUSTRY

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

An Improved Free-Machining High-Nickel Alloy

An addition to the group of high-nickel alloys has been announced by the International Nickel Co., Inc., New York City, under the designation KR Monel. The new alloy has high strength, can be fabricated in automatic screw machines, resists corrosion, and can be heat-treated after fabrication to provide additional strength and hardness. It is being produced in rod and wire forms only.

KR Monel makes available a metal which offers suitable machining characteristics, in combination with physical properties similar to K Monel. In hot-rolled rod form, it has a tensile strength of from 90,000 to 120,000 pounds per square inch, with a hardness of 140 to 225 Brinell. When cold-drawn, it has a tensile strength of from 100,000 to 125,000 pounds per square inch and a hardness of 175 to 250 Brinell. Both the hot-rolled and cold-drawn forms are available in the age-hardened types, which provide increased tensile strength and hardness.

This alloy is non-magnetic, and is thus suitable for the airplane and other industries where this property is important. The corrosion resistance of the new alloy is similar to that of K Monel and Monel. Its free-machining qualities are obtained by heat-treatment at the mill before shipment to the user. 201

New Bearing Material with Greater Load Capacity

Ability to carry heavy loads at high speeds and to withstand shock loads, freedom from consequential wear even under exacting conditions, lower frictional resistance, and good machinability are some of the features claimed for "Carobronze," a bearing material manufactured and distributed by Revere Copper and Brass, Inc., 230 Park Ave., New York City. Carobronze contains 91.2 per cent copper, 8.5 per cent tin, 0.3 per cent phosphorus—the last element being closely controlled. It is obtainable in three grades, and even in the hardest grade is said to have a high degree of ductility and resistance to shock loads.

The material is manufactured in tubular form in sizes from 1/2 inch to 3 1/2 inches outside diameter; in wire, rods, and bars up to about 3 1/2 inches in diameter; as well as in sheet and strip. Close dimensional tolerances permit, in the case of tubing, for example, clean and concentric bushings to be obtained by the removal of only a few thousandths inch from the outside and bore. The longer lengths in which this bearing material is supplied facilitate rapid and economical machining on automatic screw machines. Material and weight savings result from the use of shorter, thinner-walled bushings, which is made possible by the high load capacity of the material. 202

Thermoplastic Resin for Protecting Metal and Concrete

A thermoplastic resin coating that can be brushed or spread on metal or concrete surfaces was developed some time ago by the American Concrete and Steel Pipe Co. of Los Angeles, Calif., under the name of "Amercoat," and is now being introduced for widespread application wherever problems involving contamination or corrosion are encountered. The liquid plastic resin is usually applied in three coats. The prime coat has the property of adhering tenaciously to the surface to which it is applied, and also forms a suitable base for the second or enamel coat which has air-blown silica dispersed in it. After evaporation of the solvents in the second coat, a final coat is applied, which penetrates into the two previous coats, binds them together, and produces an impenetrable seal over the whole surface. The complete coating is approximately 1/50 inch thick, and has a gray, black, or white glossy surface.

Several types of this covering material are available to meet industrial requirements. It is odorless, tasteless, and chemically inert, and thus makes an excellent covering for food and beverage con-

To obtain additional information about materials described on this page, see lower part of page 188.

tainers and processing equipment. It will expand and contract with the base on which it is applied as changes in temperature occur. Other advantages claimed for this new material are that it will not check, crack, or fracture when subjected to vibration nor is it readily abraded; and it is resistant to salt water, cold mineral acids, alkalies, oils, fats, and aliphatic hydrocarbons, such as gasoline, all mineral salts and alcohols. However, it is not suitable for certain acids in concentrated form and for certain other substances such as aldehydes, benzine, carbon disulphide, and ether. Applications have already been found in the bottling industry, citrus juice plants, dairies, breweries, laundries, and gasoline storage plants. One interesting application is its use for protection of the hulls of sea-going boats along the water-line strip which is exposed to both salt water and air, providing an unusually severe test of resistance to salt water corrosion. 203

Synthetic Base Paint that Resists Highly Corrosive Conditions

A new grade of Koroseal paint known as "Koroplate" has been developed by the B. F. Goodrich Co., Akron, Ohio, for use under highly corrosive conditions. This paint, when dry, is extremely resistant to the action of fumes and vapors from acids, alkalies, and salts at room temperatures or slightly above. It resists all acids except concentrated formic and acetic acids, and is not affected by brass, chromium, nickel, cadmium, zinc, copper, silver, or tin-plating solutions. When thoroughly dry, it will not contaminate such solutions, although it is not recommended for constant immersion in them.

The base of the new paint is Koroseal, a synthetic material developed in the Goodrich laboratories from polyvinyl chloride, which is derived from the common materials coke, limestone, and salt. It is liquid at ordinary room temperatures, and requires no heating before application, which may be accomplished either by brushing or spraying. It is available only in semi-glossy black.

Among the successful applications of this new paint are coating of underground pipe lines, and of fume ducts in plating rooms. 204

New Galvanized Sheet with a Paint Bonding Surface

Galvanized sheet with a special surface finish termed "Colorbond" has been placed on the market by the Newport Rolling Mill Co. Division of the Andrews Steel Co., Newport, Ky. The new surface is obtained by a process that does not weaken or destroy the galvanizing. As a result, the surface of the sheet is more resistant to rust, all types of surface finishes adhere tightly to it, and the effectiveness of the paint film is also increased. Surface finishes can be applied to Colorbond sheet by any of the accepted methods—hand or mechanical brushing, spraying, or dipping—no special equipment being necessary. These galvanized sheets are supplied in three types of base metal—steel, copper steel, and pure iron-copper alloy—and in a full range of sizes and gages. 205

An Alloy Cast Iron for Dies that is Readily Flame-Hardened

A chromium-molybdenum cast iron that is suitable for use in forming and drawing dies and lends itself readily to flame-hardening with air cooling is produced by the Acme Foundry Co. of Detroit, Mich., under the trade name "Hi-Tensilloy," according to a recent issue of *The Moly Matrix*. When flame-hardened (without a water quench), this iron is said to meet a specification of 450-600 Brinell, with case depths extending to 3/32 inch. Dies cast of this material can be flame-hardened along selected areas, such as edges and corners, where wear is likely to be excessive, even though full hardening of the die is impracticable. The presence of molybdenum and chromium in the iron prevents extensive graphitization, which would otherwise tend to occur in that part of the interior zone where the temperature reaches a point just below the critical.

Two large motor car producers have adopted "Hi-Tensilloy" for units of fender-draw dies, and another large motor company is using this chromium-molybdenum iron for radiator-grille dies. One of the latter draw dies has shown little wear after producing one and one-half million pieces. When wear does occur in dies cast from this material, the die can easily be renewed by flame-annealing, machining, respotting, and hardening. 206

Monarch Metal, a New High-Lead Bearing Bronze

A bearing bronze in various high-lead combinations has recently been developed by the Monarch Alloys Co., Ravenna, Ohio, under the name Monarch Metal. This bronze is adapted to a wide range of bearing and seal applications. It is claimed that with bearings made of this material less friction, heat, and noise are produced than with the ordinary high-lead bronzes. This is attributed to the absense of hard, abrasive tin and lead oxides in the material. Owing to an improved cooling process, a better dispersion and nodulation of the lead are produced, which makes the alloy more heat-resistant. Thus, even in the case of lubrication failures, seizing or galling of the shaft is avoided. No graphite solution is needed to break in bearings of Monarch Metal. Tests are reported to show superior hardness and compression resistance..207

To obtain additional information about materials described on this page, see lower part of page 188.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at bottom of page 187 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the April Number of MACHINERY

Screw Thread Data Book

EASTERN MACHINE SCREW CORPORATION, 23-43 Barclay St., New Haven, Conn. Defense Emergency Screw Thread Data Book, containing complete information on screw thread systems, both foreign and domestic, which should be of particular value to manufacturers engaged on defense work. A charge of 15 cents is made for this publication to cover part of the cost of printing and postage. 1

Electric Equipment

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletins GEA 841K, 3517, and 3533 describing, respectively, magnetic starters for induction motors; speed variators operating on alternating-current supply; and photo-electric relays for counting, controlling, signaling, etc. Bulletin GEA-3531, entitled "How to Select Control for D-C Motors." 2

Ball and Needle Bearings

TORRINGTON CO., Torrington, Conn., and BANTAM BEARINGS CORPORATION, South Bend, Ind., are distributing a bi-monthly publication known as the "Bearing Engineer," covering applications of ball, roller, and needle bearings; new developments; and information on bearing selection and maintenance, of value to users and designers of bearings. 3

Training New Employes

KOEBEL DIAMOND TOOL CO., 9350 Grinnell Ave., Detroit, Mich., is distributing a pamphlet entitled "Meet Joe Green, Grinder Hand," pointing out the importance of training new men in the proper use of tools. This pamphlet contains, in a pocket, a booklet entitled "For Grinder Men Only," giving instructions on the use of diamond wheel-dressing tools. 4

Indicating, Recording, and Control Equipment

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. Wall calendar for 1941 (G-42), containing on each sheet helpful engineering information in the form of charts, such as fuel gas analysis checking chart, steam leakage chart, pipe data, comparative fuel costs, oil measurement table, etc. 5

Lathes

R. K. LEBLOND MACHINE TOOL CO., Cincinnati, Ohio. Seventy-two-page book entitled "America Sings," presenting by means of words and striking three-color illustrations the challenge facing industrial America, and showing the complete line of LeBlond lathes, which are also described in detail. 6

Bronze Bushings and Bearings

JOHNSON BRONZE CO., 520 S. Mill St., New Castle, Pa. Catalogue 410, covering the complete line of Johnson bronze bushings and bearings, bar bronze, and babbitt, including new sizes of plain bearings and new types of electric motor bearings, all of which are available immediately from stock. 7

Reduction Drives

AMERICAN PULLEY CO., 4200 Wissahickon Ave., Philadelphia, Pa. Catalogue R-41, describing reduction drives for driven speeds between 11 and 215 R.P.M. Catalogue W-41, on American "Wedgbelt" drives. The two catalogues supply all necessary information for laying out a complete drive. 8

Safety Clamps

NEVER-SLIP SAFETY CLAMP CO., P. O. Box 448, Grand Central Annex, New York City. Bulletin describing an improved style of safety lifting clamp, equipped with a replaceable, grooved, hardened-steel jaw liner, for lifting plates and structural shapes weighing up to 12 tons. 9

Thread Milling Machines

LEES-BRADNER CO., Cleveland, Ohio. Catalogue 52, illustrating and describing the Lees-Bradner Model CT heavy-duty thread milling machine of the chucking type, especially applicable for munitions work and other parts of considerable size that require precision threading. 10

Special Milling, Drilling, and Honing Machines

W. F. & JOHN BARNES CO., Rockford, Ill. Circulars entitled "An Introduction to 3 Point Design," and "An Example of 3 Point Design," describing special machines designed for drilling, tapping, boring, milling, or honing two specific products. 11

Roller Bearings

HYATT BEARINGS DIVISION OF GENERAL MOTORS SALES CORPORATION, Harrison, N. J., is distributing a publication known as the "Hyatt Innerscope," which shows applications of Hyatt roller bearings on various classes of equipment. 12

Molybdenum-Tungsten Steel

JESSOP STEEL CO., 605 Green St., Washington, Pa. Booklet describing the physical properties, advantages, and applications of Jessop Mogul molybdenum-tungsten high-speed steel; complete heat-treating procedure is included. 13

Slotting Heads for Milling Machines

EXPERIMENTAL TOOL & DIE CO., 12605 Greiner Ave., Detroit, Mich. Circular entitled "Double Duty," describing the Universal Slotmaster for use on milling machines. 14

Speed Reducers

WINFIELD H. SMITH, INC., Springville, Erie Co., N. Y. Bulletin GSR-Ja41, describing a line of differential speed reducers providing any reduction ratio from 4 to 1 up to thousands to 1 in one stage 15

Profile Grinders

BOYAR-SCHULTZ CORPORATION, Walnut at Hoyne, Chicago, Ill. Bulletin entitled "Cost Reducing Tools for the Tool-room," describing profile grinding machines designed to grind and fit difficult contours on dies, cams, templets, etc., at high speed. 16

Micromatic Honing Machines

MICROMATIC HONE CORPORATION, 1345 E. Milwaukee Ave., Detroit, Mich. Circular illustrating various types of Micromatic honing machines and their applications on different classes of work; includes data on capacities, accuracy, etc. 17

Hoists and Cranes

SHAW-BOX CRANE & HOIST DIVISION OF MANNING, MAXWELL & MOORE, INC., Muskegon, Mich. Bulletin 348, covering the "Budgit" portable electric hoists made by the company. Bulletin 349, describing "Budgit" crane assemblies. 18

Cellulose Acetate

HERCULES POWDER CO., INC., Wilmington, Del. Booklet on cellulose acetate, containing data on properties, application, and formulation of the material in the plastics, lacquer, electrical, automobile, and other fields. 19

Control Equipment

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. Bulletin 85-16, completely describing Brown automatic program control systems using potentiometer type controllers. 20

Gas Cutting Machines for Marine Construction

AIR REDUCTION, 60 E. 42nd St., New York City. Bulletin describing newly developed machines for aiding fabrication by welding in the marine industry. 21

Hydraulic Cold-Sawing Machines

MOTCH & MERRYWEATHER MACHINERY CO., 715 Penton Bldg., Cleveland, Ohio. Circular illustrating and describing the company's new No. 3 hydraulic-feed cold-sawing machine. 22

Welding Alloys

EUTECTIC WELDING ALLOYS, INC., 40 Worth St., New York City. Folder containing information on Castolin eutectic low-temperature welding alloys, and their application on different materials. 23

Bending Rolls

BUFFALO FORGE CO., Buffalo, N. Y. Bulletin 352-A, containing the latest data on Buffalo bending rolls for circle, segment, and spiral bending of angles, rounds, squares, beams, and special shapes. 24

Abrasives

NATIONAL METAL ABRASIVE CO., 3560 Norton Road, Cleveland, Ohio. Booklet entitled "The ABC and XYZ of Cleaning, Hardening, Surfacing, Relieving Metal Fatigue, Strain, etc., by Controlled Abrasives." 25

Resistance Welders

THOMSON-GIBB ELECTRIC WELDING CO., Lynn, Mass. Circular on the Thomson standard line of resistance welders, including spot welders, welding presses, seam welders, and flash welders. 26

Deep-Hole Drill Sharpening Machines

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford, Conn. Circular 450, illustrating and describing deep-hole drill sharpening machines. 27

Hobs and Hobbing Machines

BARBER-COLMAN CO., 203 Loomis St., Rockford, Ill. Data Sheet No. 17, containing production data on machining spline shafts by the use of Barber-Colman Type A hobbing machines. 28

Arc-Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Application Sheet No. 73, in a series on Machine Design, showing the application of arc-welding in designing a hand-lever for a press. 29

Files

AMERICAN SWISS FILE & TOOL CO., 410 Trumbull St., Elizabeth, N. J. Catalogue showing more than 3000 files of different shapes, cuts, and sizes. 30

To Obtain Copies of New Trade Literature

listed on pages 186-188 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

Pin Type Insulators

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Descriptive Data 39-180, covering pin type insulators for power transmission service. 31

Tool and Cutter Grinder

OLIVER INSTRUMENT CO., 1410 E. Maumee St., Adrian, Mich. Catalogue illustrating and describing the Oliver "Ace" universal tool and cutter grinder. 32

Light-Wave Equipment

VAN KEUREN CO., 176 Waltham St., Watertown, Mass. Booklet containing complete instructions for using the Van Keuren light-wave equipment. 33

Tapping Machines

CLEVELAND TAPPING MACHINE CO., Cleveland, Ohio. Bulletin 2-41, illustrating and describing Cleveland finger-tip controlled automatic tapping machines. 34

Motor Drives

WESTERN MFG. CO., 3428 Scotten Ave., Detroit, Mich. Circular describing two models of transmissions for motorizing cone-driven machine tools. 35

Steel Safety Mat

WILLIAM F. KLEMP CO., 6601 S. Melvina Ave., Chicago, Ill. Circular descriptive of the Klemp steel safety mat for industrial use. 36

Nickel Alloys

INTERNATIONAL NICKEL CO., INC., 67 Wall Street, New York City. Bulletin T-7, containing data on the engineering properties of Inconel. 37

Dust Collecting Equipment

AMERICAN FOUNDRY EQUIPMENT CO., 399 S. Byrkit St., Mishawaka, Ind. Booklet describing how dust problems can be controlled by the use of American dust collecting equipment. 38

Aluminum Bronze for Aircraft Parts

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis. Booklet entitled "Controlled Aluminum Bronze for Aircraft Parts." 39

Cutting Tools

KELLY REAMER CO., Cleveland, Ohio. Catalogue T, covering the complete Kelly line of production tools for all classes of boring, reaming, and milling jobs. 40

Tracing Cloths

ARKWRIGHT FINISHING CO., Turks Head Bldg., Providence, R. I. Catalogue (6½ by 3¼ inches), covering Arkwright and Prudence tracing cloths. 41

Vertical Milling Machines

MIDWAY MACHINE CO., 2324 University Ave., St. Paul, Minn. Circular illustrating and describing Millmaster vertical milling machines. 42

Hydraulic Straightening Presses

A. B. FARQUHAR CO., LTD., York, Pa. Bulletin 41-H-01, descriptive of Farquhar hydraulic straightening and general-purpose presses. 43

Stainless Steels

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa. Blue Sheet 109, on the fabrication of Allegheny stainless steels. 44

Superfinished Bronze Valves

HANCOCK VALVE DIVISION OF MANNING, MAXWELL & MOORE, INC., Bridgeport, Conn. Bulletin on Hancock Superfinished "500 Brinnell" bronze valves. 45

Pre-Finished Metals

AMERICAN NICKELOID CO., Peru, Ill. Folder entitled "Speed up with Pre-finished Metals." 46

* * *

A.S.M.E. Spring Meeting

The national spring meeting of the American Society of Mechanical Engineers will be held in Atlanta, Ga., March 31 to April 3. At this meeting there will be sessions on education and training for the industries, power plant equipment and operation, hydraulics, materials handling, textiles, and fuels. Excursions are being arranged to the Georgia Power Co.'s Atkinson plant, the Atlantic Steel Co.'s plant, and the Le Tourneau Co.'s shops at Toccoa, Ga.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 189-210 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description on pages 189-210—or write directly to the manufacturer, mentioning machine as described in April MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 184-185, fill in below the identifying number found at end of each description on pages 184-185—or write directly to the manufacturer, mentioning name of material as described in April MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Sundstrand Machines Equipped for Shell Work

Machines recently built by the Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., for operations on 81-millimeter shells include the hydraulic centering machine equipped as shown in Fig. 1, and the Model 10 automatic stub lathe illustrated in Fig. 2. The machine shown in Fig. 1 is equipped for the boring and centering operation. It has two motor-driven heads, each with independent spindle speed adjustment through pick-off gears.

Feeding of the heads in opposed directions is controlled hydraulically by means of a self-contained pump and tank unit. An adjustable positive stop limits the travel of the heads. The right-hand head carries the combination multi-blade boring and facing tool which rough- and finish-bores and faces the open end of the shell. The left-hand head carries the center drill. A combination counterboring, facing, and centering tool can be used in the left-hand head if required.

Two self-centering hydraulically operated vises with form-fitting jaws grip the shell on the outside diameter. A centering type end-stop locates the shell endwise from the small end, which is milled in a previous operation. After placing the shell in the machine, the operator presses a button, starting the automatic cycle which consists of rapid approach, feed, dwell, rapid return, and stop.

Stellite and high-speed steel tools are employed at a speed of 75 surface feet per minute, with a feed of 0.010 inch per revolution. The floor-to-floor time required for this operation is 1.50 minutes, the production being 34 pieces per hour.

The Model 10 automatic lathe performs the semi-finish turning operation with the part held and driven by an air-operated expanding type driver attached to the machine spindle. This driver locates the part from the large end of the shell, which was bored and faced in the previous operation. A foot valve controls the clamping and unclamping of the driver, permitting the operator to use both hands for loading and unloading the work. Three cam-bar controlled tools and two straight turning tools which turn the irregular contour are mounted on the front tool-slide, which is provided with longitudinal feed.

After the part is loaded, the machine goes through the regular automatic cycle of rapid approach, feed, rapid return, and stop, all operations being timed and interlocked with the starting and stopping of the machine spindle and the starting and stopping of the flow of coolant. The tools employed for this job are tipped with tungsten-carbide, and operate at a speed of 250 surface feet per minute, with a feed of 0.016 inch per revolution. The floor-to-floor time is 1.20 minutes, and the regular production rate 42 pieces per hour.

The Model 10 automatic stub lathe shown in Fig. 2 is used for the succeeding or finish-turning operation. The machine used for this finishing operation is exactly the same as the one used for semi-finish turning, except that a rear slide is provided which carries chamfering and grooving tools. A two-speed 3 to 1 ratio spindle motor is used, so that the spindle speed can be automatically reduced just before the grooving tools are fed into the work. Stellite tools and tools tipped with tungsten-carbide are used for this finishing

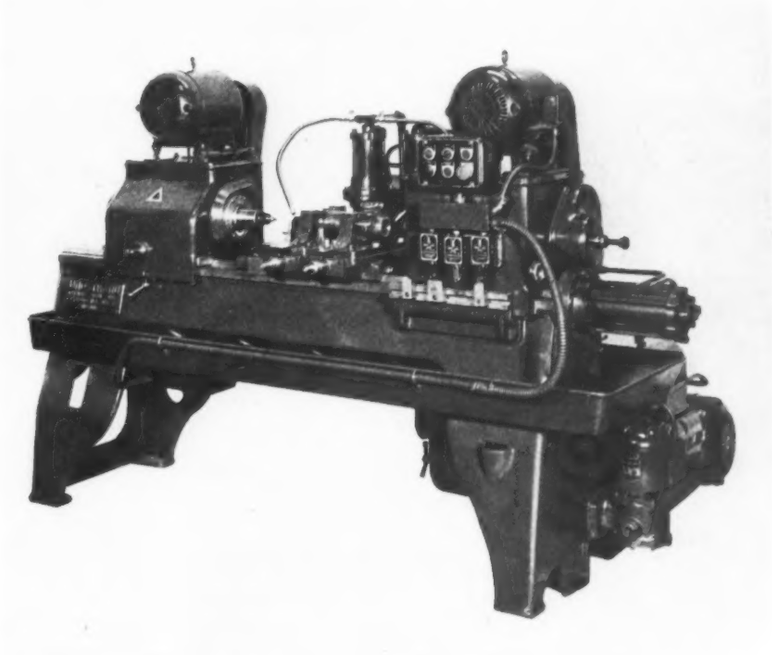


Fig. 1. Sundstrand Hydraulic Centering Machine Equipped for Operations on 81-millimeter Shells

To obtain additional information on equipment described on this page, see lower part of page 188.

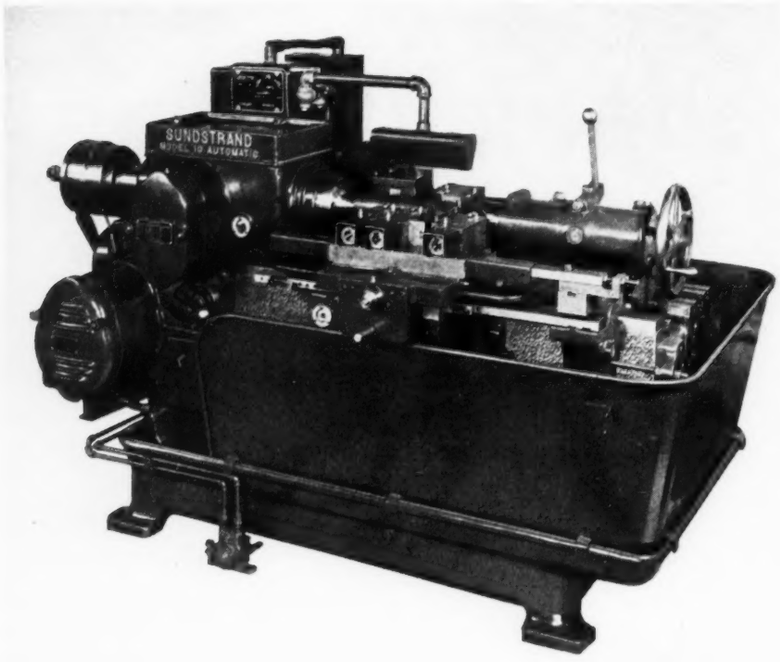


Fig. 2. Sundstrand Model 10 Automatic Stub Lathe Equipped for Shell-turning Operations

operation, employing a speed of 250 surface feet per minute for turning and a speed of 83 surface feet per minute for grooving. The feed employed is 0.016 inch per revolution. The floor-to-floor time is 1.40 minutes, and the regular production 36 pieces per hour. 51

Brown & Sharpe Formed-Cutter Sharpening Attachments

Two formed-cutter sharpening attachments—one a "through feed" type and the other an "in feed" type —have recently been added to the line of grinding equipment made by the Brown & Sharpe Mfg. Co., Providence, R. I. These attachments were designed for use with the B & S No. 10 cutter and tool grinding machines. Similar attachments are also available for the B & S No. 13 universal and tool grinding machine.

The "through feed" attachment consists of a rigid, adjustable, tooth-rest assembly mounted on the top of a sturdy column which is adjustable vertically to accommodate formed cutters up to 6 inches in diameter. A dish wheel is used, with the wheel-spindle located at right angles to the table. The cutter is supported on a horizontal arbor between the centers of the machine, as illustrated in Fig. 1, and is passed across the face of the wheel by traversing the table. A rack and pinion provide easy, positive adjustment, and the rack serves as a key to maintain angular alignment. The transverse adjustment of the attachment allows the tooth-rest to be positioned for grinding the tooth radial or with hook or drag. A stop-nut is provided on the tooth-rest adjustment to facilitate grinding cutters to uniform size.

With the "in feed" attachment, formed cutters from 2 to 6 1/2 inches in diameter, with straight teeth, can be rapidly and accurately sharpened. A dish wheel is also used with this attachment. The wheel-spindle is set at right angles to the table, and the cutter is supported on its side in a horizontal plane and advanced into the edge of the wheel, as shown in Fig. 2, by feeding the table to the left. Since the inner edge of the tooth-face area thus ground has a curvature caused by the circumfer-

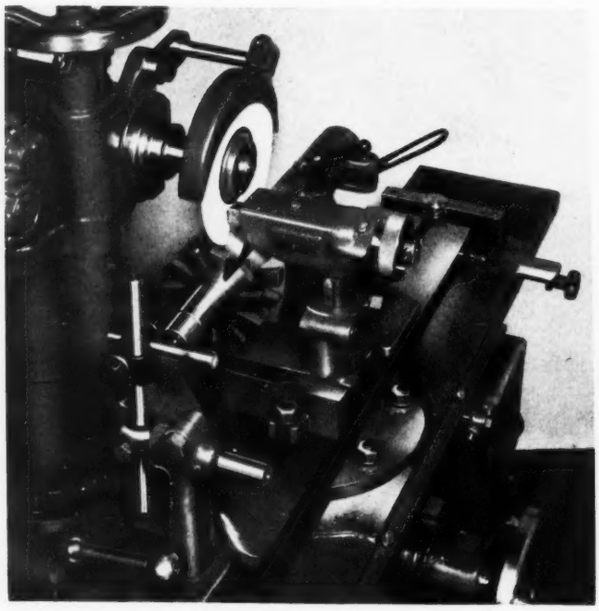


Fig. 1. B & S Through-feed Cutter Sharpening Attachment

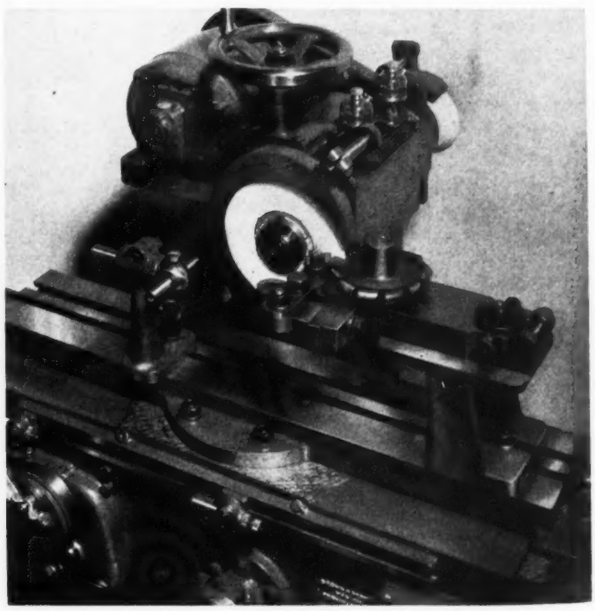
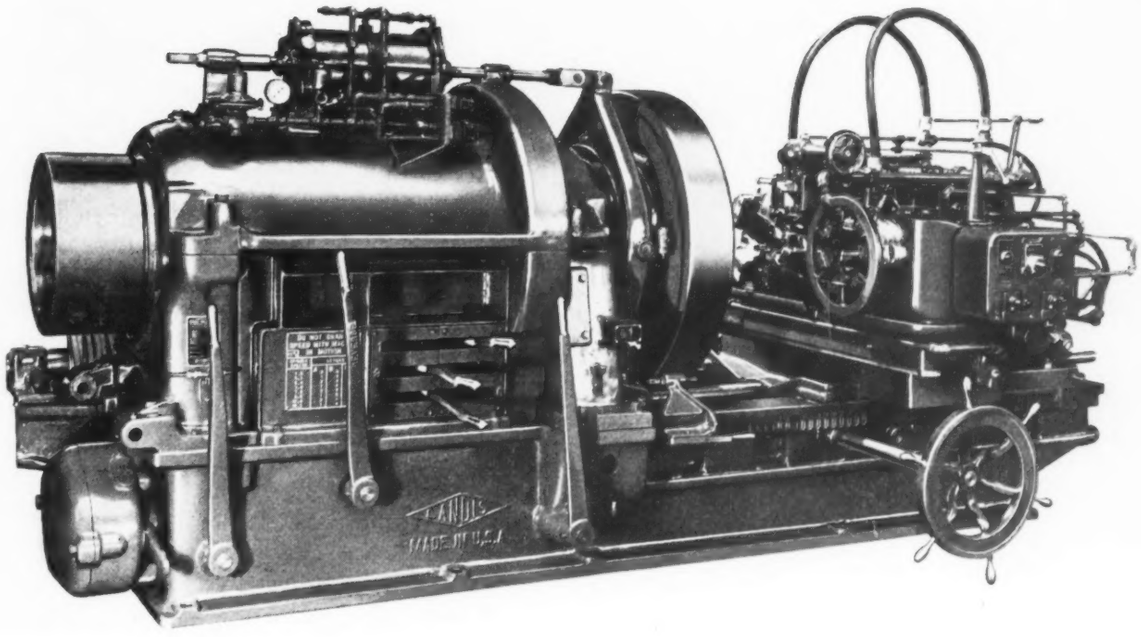


Fig. 2. B & S In-feed Cutter Sharpening Attachment

To obtain additional information on equipment described on this page, see lower part of page 188.



Bomb Turning and Threading Machine Brought out by Landis Machine Co.

ence of the 6-inch diameter wheel, this attachment is generally recommended for sharpening cutter teeth not more than 1 1/2 inches in width. The transverse adjustment permits the tooth-rest to be positioned for grinding the tooth radial or with hook or drag. This attachment is designed so that the operator can quickly index the cutter with one hand and feed the table with the other.

A wheel-spindle extension for the left-hand end of the grinding machine spindle is regularly included with each of these attachments. In the case of the "in feed" attachment, three cutter-arbors are also regularly furnished to take cutters with 7/8-, 1-, and 1 1/4-inch holes.....52

New Pulley Compound Prevents Belt Slippage

A compound which is applied to pulleys by brushing has been recently introduced by the Warren Pulley Cover Co., Danielson, Conn. This compound is applied as easily as paint, and dries quickly, providing a surface that is adhesive without being sticky. Thus belt slippage is eliminated, so that wear on belts and journals is reduced and the efficiency increased. One application is said to last for from one to two years...53

Landis Bomb Turning and Threading Machine

A machine for completely finishing the tail end of bombs at one chucking has been designed by the Landis Machine Co., Waynesboro, Pa. Three tool units attached to a carriage and cross-slide are provided for turning, facing, chamfering, boring, recessing, and threading operations.

The bomb to be machined is pushed through the bore of the spindle from the rear until it comes in contact with a work-locating device, when it is gripped by the pneumatically operated chuck. A turning and facing tool-slide is then rapidly advanced toward the bomb, and automatically brought to a predetermined turning feed rate just before the tools enter the cut. A second predetermined rate of feed is automatically engaged just before the tools start the facing cut. At the completion of the turning, chamfering, and facing operations, the tool-slide is withdrawn rapidly, and the cross-slide is indexed against the mid-position stop, bringing the boring tool-slide into the working position.

The boring tool-slide is advanced rapidly toward the work and automatically reduced to a predetermined rate of feed before the tools come in contact with the work. At the end of the boring operation, the recessing tool is fed by hand to a positive stop for finishing the angular surface and adjacent recess on the body of the bomb. After the recessing tool is returned from the cut, the boring tool-slide is rapidly withdrawn from the work and the cross-slide moved against a third stop which brings the 40 AX Landmatic die-head into the operating position.

The end of the bomb is then threaded, using the lead-screw mechanism to provide positive and accurate travel for the carriage. The lead-screw nuts automatically open when the threading operation is completed. The carriage and cross-slide are then returned to the original starting position, and the bomb is removed from the machine.

All movements of the tool-slides, as well as those of the cross-slide, are hydraulically controlled with circuits arranged with interlocks to assure the correct sequence of operations. The cross-slide is hydraulically locked in position on the carriage when any one of the tool-slides is in action. The operating controls, conveniently centralized at the front of the machine, give the operator full control from a position that permits observation of the tools throughout the entire machining cycle.

The machine is equipped with a

To obtain additional information on equipment described on this page, see lower part of page 188.

variable-speed motor-driven headstock, which includes a selective sliding gear transmission providing eight speed ranges for almost infinite variations, from minimum to maximum spindle speeds. The lead-screw mechanism is mounted in the bed, and is equipped with a pick-off gear drive that provides a range of from 6 to 14 threads per inch. A lead-screw indicator is built into the carriage. 54

Colonial Pull-Down Broaching Machines

Pull-down broaching machines previously available only on special order and in a limited number of sizes are now being placed on the market by the Colonial Broach Co., 147 Jos. Campau, Detroit, Mich., in a complete line of regular sizes ranging from 3 to 20 tons capacity, with strokes of from 24 to 60 inches. Machines of larger tonnage capacities can also be made to order. These pull-down type broaching machines are especially adapted for use in the manufacture of precision parts for aircraft engines and similar parts which might be damaged by dropping, since the part to be broached lies flat on the platen or is held in a fixture mounted on the platen. Pull-down machines are also especially suitable where indexing of the part to the broach is necessary, as when locating a splined hole relative to the teeth of a gear.

These machines provide completely automatic handling of the broach through the use of a hydraulic mechanism located at the top of the column. With this arrangement, it is unnecessary for the operator to touch the broach at any time. In the operating cycle, the broach is held at the top of its stroke by the handling mechanism, and uncoupled at the bottom so as to permit placing the part in position on the platen. As soon as the pilot on the broach passes through the part, the broach is automatically attached to the pull-down mechanism and is uncoupled at the top. After the part is removed, the broach is pushed upward until it engages the cup of the automatic handling mechanism. It is then returned to the top of the stroke to permit insertion of the next piece to be broached. A fully enclosed hydraulic drive is employed, and the speeds are variable, being normally, 30 feet per minute on the working or down stroke of the broach and 60 feet per minute on the return stroke. 55

Cleveland Tapping Machine

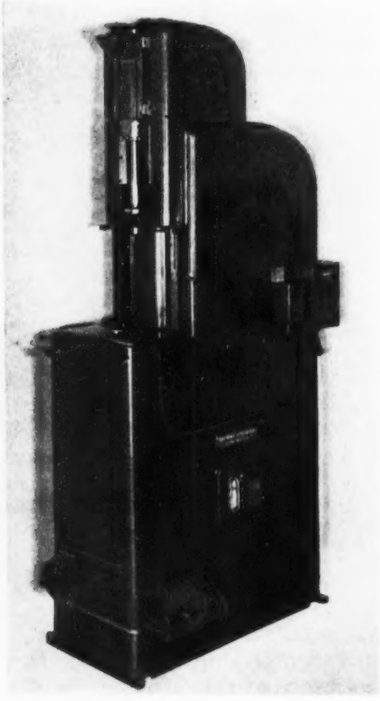
An improved model tapping machine designed with a view to obtaining lightness, compactness, and ease of handling has recently been brought out by the Cleveland Tapping Machine Co., 1725 Superior Ave., Cleveland, Ohio. One of the new features of this model is that holes of different depths can be tapped without changing the stop-gage. This is accomplished by means of a spacer hinged on the housing and made to contact with the reversing lever. Thus the operation of the machine is almost completely automatic.

The machine has a rigid spindle mounted in ball bearings, and control is effected by either hand- or foot-lever. The clutch facings have been changed from woven facings to bi-metal. A 1-H.P. motor is provided as standard equipment, and a V-belt drive utilizing a four-speed pulley gives speeds of 260, 480, 590, or 820 R.P.M. This machine will handle taps ranging from 1/4 to 1/2 inch in steel. 56

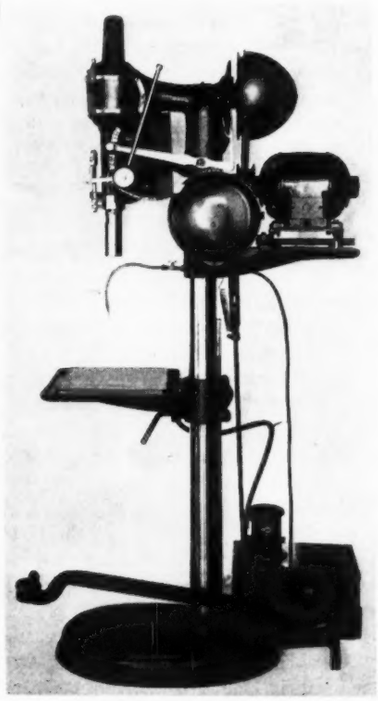
"S-O-S" Variable-Speed Motor Pulley

A new variable-speed motor pulley designed for use with light, inexpensive machinery has been announced by the Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill. This pulley is mounted directly on the motor shaft and requires only standard V-belts. The complete unit includes a variable-pitch pulley and an adjustable sliding motor base. By turning the handwheel of the base, the motor is moved backward or forward to increase or decrease the belt tension. This causes the pulley to open or close, changing the pitch diameter and the driven speeds. Speed changes are made while the drive is running.

Some of the features of the new design are short overhang, forced lubrication, balanced sheave, and all-metal construction. Both halves of the sheave move, thus maintaining accurate belt alignment. The pulley faces are curved, so that the belt has full contact at all pitch diameters. These pulleys are made in three sizes ranging from 1/8 to 3/4 H.P., with speed ratios up to 2 3/4 to 1. 57



Pull-down Broaching Machine Made by Colonial Broach Co.



Cleveland Tapping Machine with Automatic Split-second Reverse

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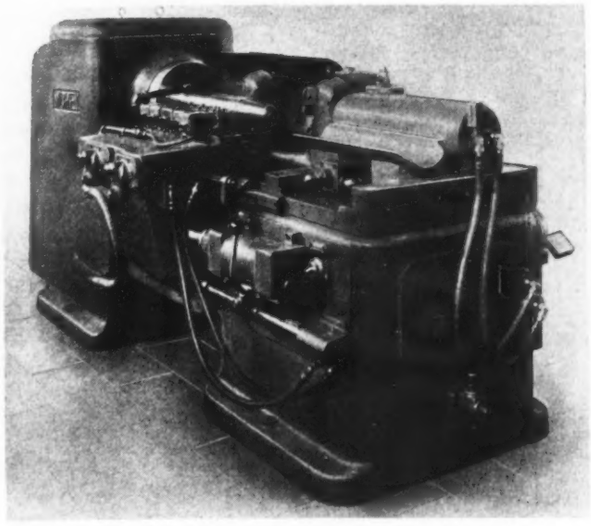
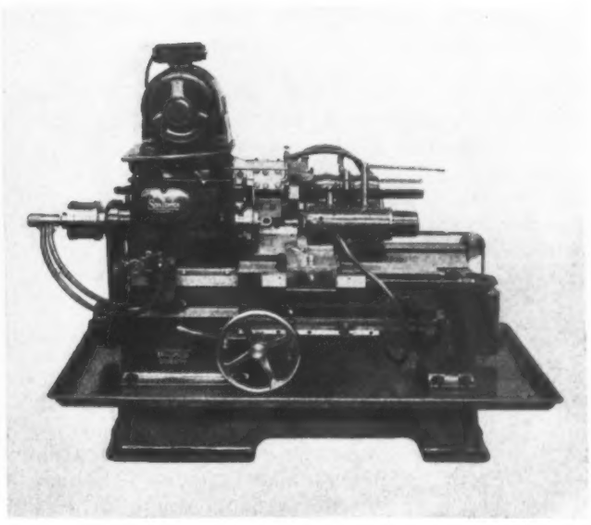


Morey Semi-automatic Lathe Equipped for Rough-turning 155-millimeter Shells



Smallpeice Multicut Production Lathe Manufactured by Reid Brothers Co., Inc.

Morey Semi-Automatic Lathe Equipped for Rough-Turning Shell Forgings

The 27-inch semi-automatic lathe developed by the Morey Machinery Co., Inc., 410 Broome St., New York City, has recently been equipped for rough-turning shell forgings in sizes from 105 up to 155 millimeters. The shell-handling facilities provided by the novel tailstock design is an outstanding feature of this lathe. A steel trough on the front side of the tailstock receives the shell forging. Automatic crosswise movement of the tailstock at right angles to the lathe bed ways carries the shell forging into alignment with the work-holding arbor. From this position, the forging can be easily pushed on the arbor by a sliding endwise movement.

After sliding the forging on the arbor, a lever is moved, causing the tailstock to automatically move crosswise of the bed to its former operating position, and the quill to move to the center of the forging and force the shell into the machining position. Movement of a lever at the left-hand side of the machine causes the arbor to expand and hold the forging. A third lever is moved to start the spindle. The tools are brought into their operating positions in proper sequence, the boat-tail portion of the shell forging being rough-turned or shaped by an easily removable form tool, while the body of the shell is rough-turned by tools held in four holders which operate simultaneously, the rear holders being brought into position to face and cut off the forging to the required length. When the turning operation is completed, the tools are automatically withdrawn and returned to the starting or non-operating position. The spindle then stops automatically, thus making the lathe ready to receive the next forging. The time required for rough-turning 155-millimeter shells with the machine equipped as shown is one minute, thirty seconds.

The lathe bed is designed with large openings for chip clearance, and has provision for a conveyor system for removing the chips as quickly as they are produced. The machine is entirely self-contained, and can be readily adapted for other operations. Provision is made for equipping the headstock with a main driving motor of 35 to 100 H.P. to suit the work. The hydraulic pump for the feeding movements is operated by a 5-H.P. motor, and a 5-H.P. motor is employed to operate the chuck-closing mechanism of the machine.

The height from the floor to the center of the spindle of this machine is 42 inches; the swing over the ways, 28 inches; and the swing over the carriage slide, 11 inches. The length of the feeding movement imparted to the slide is 9 inches, but this can be increased or decreased to suit requirements. The distance from the end of the spindle nose to the tailstock center is 28 inches; this can be increased by lengthening the machine bed. The hole through the spindle is 6 1/2 inches in diameter. The approximate weight of the machine is 14,000 pounds.....58

Smallpeice Multicut Production Lathes

Reid Brothers Co., Inc., Beverly, Mass., is now manufacturing the Smallpeice Multicut production lathes of the design of Smallpeice, Ltd., Coventry, England. These lathes are built in three sizes. The 6-inch size, with a 7-H.P. drive, will swing work 12 inches in diameter over the bed and 6 inches in diameter over the cross-slide. The 9-inch lathe, with a 20-H.P. drive, will swing work 18 inches in diameter over the bed and 9 inches in diameter over the cross-slide. The 12-inch lathe, with a 70-H.P. drive, will swing work 24 inches in diameter over the bed.

The 9-inch lathe, which is now in production, is shown in the accompanying illustration arranged for turning and finning aluminum pistons. This lathe will be followed by the 12-inch lathe which is particularly suited for turning shells up to 6 inches in diameter. All tools are mounted at the back of the lathe to make room for special facilities for loading and unloading the work. The direction of spindle rotation is reversed to throw the load downward on the tools.

Special equipment for a wide range of work is available for the 9-inch lathe. For shell production, special equipment has been developed for operations such as rough-turning and facing, nose-boring, finish-turning, driving-band groove forming and waving, driving-band turning, turning baseplates, and final base facing.

Other special equipment is available for turning short stub shafts and long slender shafts; machining

To obtain additional information on equipment described on this page, see lower part of page 188.

spur and bevel gears all over, with the gears mounted on an arbor; boring, facing, and turning ring type gears; veeing commutators before assembly on the armature and finish-turning armatures; facing and turning head, and turning radius and stem of airplane engine valves; finish-turning valve guides on an arbor; turning, profiling and forming test pieces; boring and facing piston skirts, and turning, grooving, and facing pistons; rough- and finish-turning and forming fins on airplane engine cylinders; rough- and finish-turning cylinder liners; turning journals and ends of crankshafts; turning and facing the halves of steel-backed bearings; and turning, facing, and fine-boring bushings. 59

Stokes Rotary Tablet-Compressing Machines

The F. J. Stokes Machine Co., 5930 Tabor Road, Philadelphia, Pa., has added to its line a new and larger size rotary tablet-compressing machine which is capable of applying 30 tons pressure for the production of parts up to 2 1/2 inches in diameter. This machine has a maximum die fill of 4 inches, is arranged for making cored and special-shaped pieces, has ten sets of punches and dies, and applies pressure from both top and bottom simultaneously.

Like previous machines of this type, the new machine is especially adapted for compressing oilless bearings, iron core magnets, valve seats, iron gears, pump seal rings, motor brushes, and many similar products of powder metallurgy. It is also used for compressing chemicals, explosives, dry cell plates, salt sticks and salt cakes, ore briquettes, molding powder preforms, and many other materials and products.

The machine is of steel and semi-steel construction throughout, weighs 16,000 pounds, and is 8 feet 4 inches high. The motor drive is direct, through a geared speed reducer. A patented, combined pressure equalizer and automatic, excess-pressure release is provided to prevent jamming or breakage from overloads. The output of the machine is 150 pieces per minute when the full number of ten punch and die sets are in use. 60

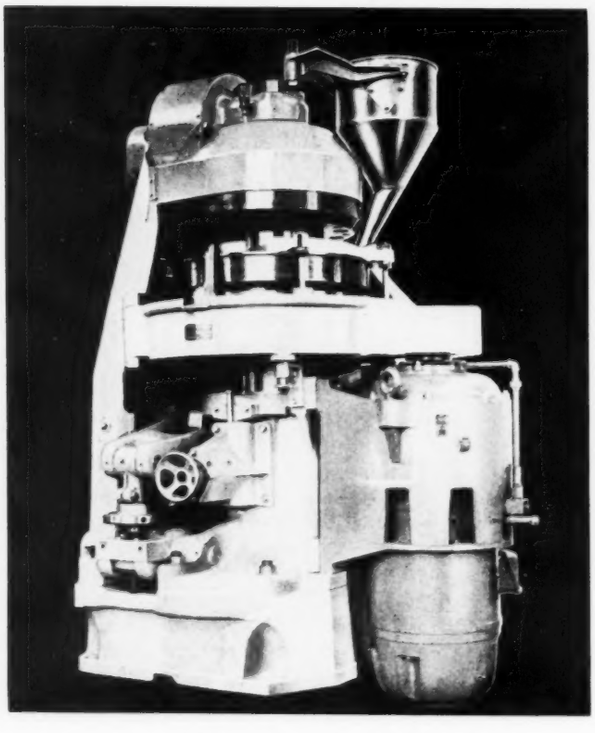
Gulf Ball and Roller Bearing Greases

The Gulf Oil Corporation, Gulf Bldg., Pittsburgh, Pa., has developed two new lines of lubricating greases for ball and roller bearings. One, designated the "Gulf Anti-friction Grease," is recommended for heavy-duty service; the other, known as "Gulf Precision Grease," is recommended for lighter duty and higher speeds. Both greases have a high melting point and are especially prepared to insure the greatest possible resistance to oxidation and separation. These lubricants are available in a wide range of consistencies for any method of application or operating condition. 61

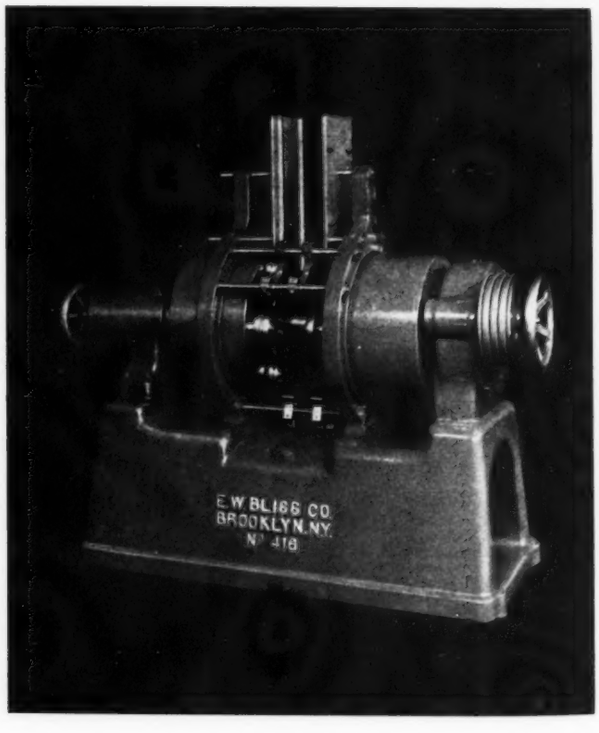
Bliss Can-Body Flanging Machine

The E. W. Bliss Co., 53rd St. and 2nd Ave., Brooklyn, N. Y., is placing on the market its recently designed No. 416 round-can flanging machine. This high-speed flanger operates with all vital parts running in a bath of oil. It is an entirely automatic, continuously operating machine designed to produce accurate uniform flanges on both ends of can bodies simultaneously.

The adjustments necessary for changing from one size can to another are few, and can be made easily. The machine will flange cans from 4 to 6 5/8 inches in diameter, and 2 to 12 inches in height. 62



Rotary Tablet-compressing Machine Made by F. J. Stokes Machine Co.



Bliss Automatic Flanging Machine Designed to Flange Both Ends of Can Bodies Simultaneously

To obtain additional information on equipment described on this page, see lower part of page 188.

Heppenstall Heavy-Duty Lathe for Roughing Operations

The manufacturing and sales rights for the new heavy-duty lathe here illustrated have been awarded to the Lewis Foundry & Machine Division of the Blaw-Knox Co., Pittsburgh, Pa., by the Heppenstall Co., Pittsburgh, Pa. This heavy-duty lathe was developed recently by the Heppenstall Co. for rough-machining operations on forgings and large sections. Hydraulic feed, live tailstock center, and selective stepless speeds and feeds are features of this machine, which has a simplified carriage with hardened wear plates on the bed and the cross-feed slide. All rotating shafts are mounted on anti-friction bearings.

The feed is provided by means of an electric drive through V-belts from the back-gear shaft, which is in constant mesh with the main spindle. The direction of feed is controlled by a hand-lever. Any selected feed can be maintained, regardless of a change in the main headstock speed. The start and stop button for the main motor and the start button for the rapid traverse are mounted on the carriage.

The tailstock is of the Heppenstall patented live-center type, and is equipped with ball and roller bearings. Electrical equipment includes a main drive motor of 25 to 30 H.P. with speeds of 300 to 1200 R.P.M.; a 3-H.P. motor for rapid traverse with a speed of 1200 R.P.M.; and a 1/3-H.P. motor for the lubricating pump.

Dimensions and specifications are: Maximum length over all, 32 feet; maximum width, 56 inches; swing over bed, 36 inches; swing over carriage, 20 inches; maximum distance between centers, 20 feet; height of center above bed, 16 inches; width of bed, 32 inches; depth of bed, 30 inches; diameter of main feed-screw, 3 inches, and diameter of cross-feed screw, 1 3/4 inches; main spindle speed, 10 to 40 R.P.M. and 40 to 160 R.P.M.; feeds, from 0.020 to 0.450 inch; and weight, approximately 36,000 pounds. 63

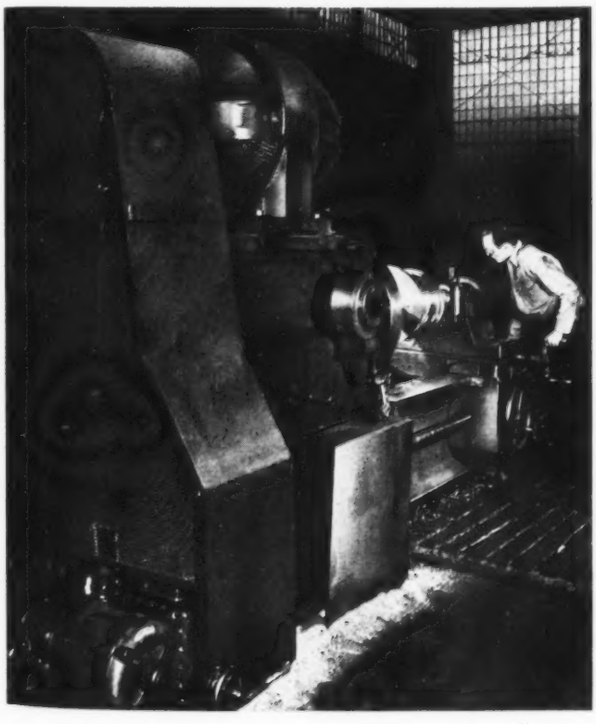
Tool-Room Precision Lathe for Small Work

A Model A, 9-inch swing, tool-room precision lathe has recently been brought out by the South Bend Lathe Works, 722 E. Madison St., South Bend, Ind., for small-diameter work requiring a high degree of accuracy. It has a maximum collet capacity of 1/2 inch, a maximum swing over the bed ways of 9 1/8 inches, and a maximum swing over the saddle cross-slide of 5 1/2 inches. This lathe is now available in three bed lengths which provide center distances of 16, 22, and 28 inches.

Twelve spindle speeds ranging from 41 to 1270 R.P.M. are provided on the motor-driven models. Smooth operation at high speeds is attained by using a direct belt drive to the spindle for speeds above 400 R.P.M. A wrenchless bull-gear lock permits engaging the back-gear quickly when slow speeds are required.

A series of forty-eight power longitudinal cross-feeds and forty-eight screw-thread pitches, either right- or left-hand, are provided for by the quick-change gear mechanism. The full automatic apron is equipped with a powerful worm drive and friction clutch for operating the automatic power cross-feeds and longitudinal feeds. An automatic safety interlock makes it impossible to engage the half-nuts when the power carriage-feeds are in use.

Equipment regularly supplied includes the handwheel type draw-in collet chuck, collet rack, taper attachment, thread dial indicator, micrometer carriage stop, and chip pan. Other attachments supplied to order include an electrical grinding



Heppenstall Hydraulic Feed Heavy-duty Lathe for Roughing Operations

South Bend Precision Lathe Designed for Small-diameter Work

To obtain additional information on equipment described on this page, see lower part of page 188.

attachment, milling attachment, oil-pump and piping, chucks, and accessories. This lathe is made in a floor type with pedestal motor drive, as illustrated, and is also available in a bench type with motor drive, and in both bench and floor types with countershaft drive. 64

Glenn-Roberts Multi-Purpose Welder

A new 2000-ampere, multi-purpose arc welder for heavy-duty applications has been brought out by the Glenn-Roberts Co., Inc., 1009 Fruitvale Ave., Oakland, Calif. This new welder, known as Model 85, is designed to operate either as a single-circuit welder with a current range of 100 to 2000 amperes or as a two-, three-, or four-operator multi-circuit machine.

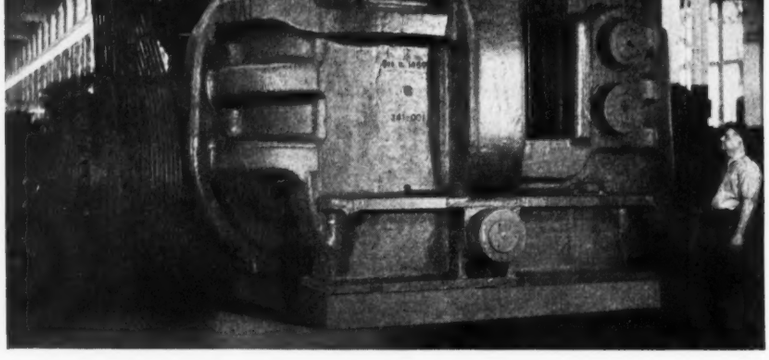
Each of the four welding circuits has an independently controlled output range of 90 to 625 amperes, and any combination of lines may be made to gain higher amperages. Remote control equipment provides stepless, full-range current control for each circuit or combination from a push-button station located anywhere in the welding work area or mounted directly on the flare shield of the welding tongs. Self-contained contactors and switches are included for automatic and Union-Melt welding. 65

Giant Forging Machine

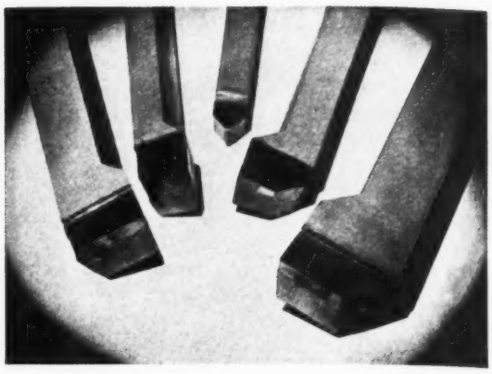
The National Machinery Co., Tiffin, Ohio, has just completed what is claimed to be the largest forging machine in the world. This huge machine has a rated capacity of 9 inches and weighs more than 500,000 pounds. Like smaller machines made by this company, it has been designed to obtain the utmost in compactness in order to secure the stiffness and rigidity so essential to the production of accurate machine forgings.

The degree to which compactness has been attained in this machine may be visualized by considering the fact that its weight is greater than the combined weight of 140 automobiles. If parked end to end, these cars would extend for more than half a mile, whereas the forging machine of equivalent weight could be accommodated in the space occupied by four cars.

The heading and gripping slides are of the over-arm suspended bearing type, and wedge adjustments are provided at the sides of both of these slides to insure accuracy of alignment. The National tandem, by-pass automatic grip relief, combined with the friction-slip flywheel, protects the machine against accidents. A new air-cooled friction clutch permits the machine to be started instantly and at high speed. Finger-tip action, positive control with complete safety enables the operator to obtain high output with a minimum of effort. 66



Giant Forging Machine Built by the National Machinery Co.



Five New Carboloy Tools Now Made in Twenty-one Sizes

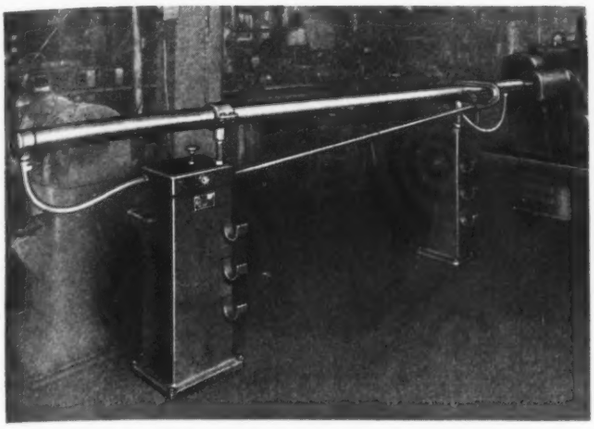
Additions to Carboloy Standard Tool Line

The addition of five new styles to its low-priced mass-production line of standard tools has just been announced by Carboloy Company, Inc., 11147 E. Eight Mile Road, Detroit, Mich. These new tools, which are available in twenty-one sizes, comprise four offset types and a two-way square-shank turning style—each type, except the last, being made in two grades, one for steel cutting and one for cast iron and other metals.

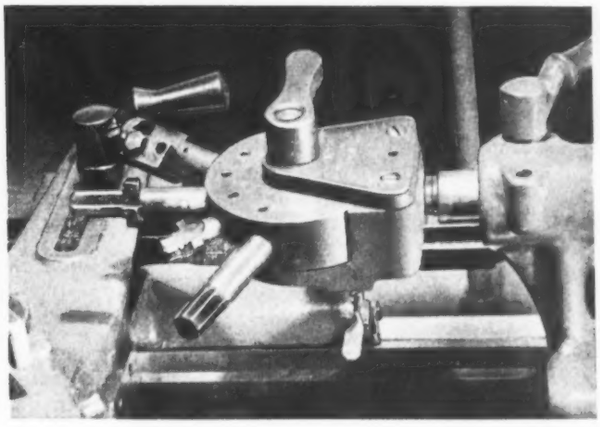
Of the new tools, the two-way turning tools (Style No. 12) have tips of 883 Carboloy, and are available in five sizes, ranging from 5/16 to 3/4 inch square shanks, for machining cast iron, non-ferrous metals, etc. The various offset tools are designated Styles Nos. 5, 9, 10 and 11. Of these, 5 and 9 are, respectively, right- and left-hand turning tools, while 10 and 11 are right- and left-hand facing tools. All of these are available in the following shank sizes: 3/4 by 1; 1 1/4 square; 5/8 by 1 1/4; and 1 by 1 1/4 inches. Chip breakers are provided on Styles 5 and 9 for steel cutting, but not on Styles 10 and 11, since the shape of chip breakers on these tools is largely dependent on their application.

For general-purpose machining of cast iron, non-ferrous metals, etc., these offset tools are stocked in grade 883 Carboloy for the 3/4- by 1-inch size, and in grade No. 44A for the remaining sizes, used for heavier cuts. For special requirements, the 3/4- by 1-inch tools are also available at standard tool prices with tips of 44A Carboloy, while the 1 1/4 square, 5/8 by 1 1/4 and 1 by 1 1/4 inch sizes are also available with tips of 883 Carboloy at no increase in price. Tools so tipped are not stocked, but are available on special order. 67

To obtain additional information on equipment described on this page, see lower part of page 188.



Pneumatic Feed for Bar Stock, Made by W. C. Lipe, Inc.



"Quadruplex" Turret Brought out by Specialties Mfg. Co.

Lipe Pneumatic Feed for Screw Machines and Turret Lathes

An air-operated automatic stock-feeding device for use with machine tools having fixed stops for determining work lengths has been brought out by W. C. Lipe, Inc., Syracuse, N. Y. This device is designed to feed the bar stock forward instantly when the collet is opened and to hold the stock firmly against the machine stop until the collet is closed. It will handle all sizes and shapes of bars within its capacity without changes in set-up. The stock is inserted in the open front end of the air cylinder, and is entirely enclosed, so that there is no danger of a whipping end catching the workman's clothing. The feeding piston within the cylinder has a ball-bearing cup center which supports the free end of the stock and is operated by air at a very low pressure.

This unit is especially adapted for feeding polished brass, aluminum, thin tubing, plastics, rectangular shapes, piston-rod stock, and similar material. It is made in three models with capacities for handling stock from 1 to 2 1/2 inches in diameter in 12-foot lengths. 68

"Quadruplex" Tailstock Turret

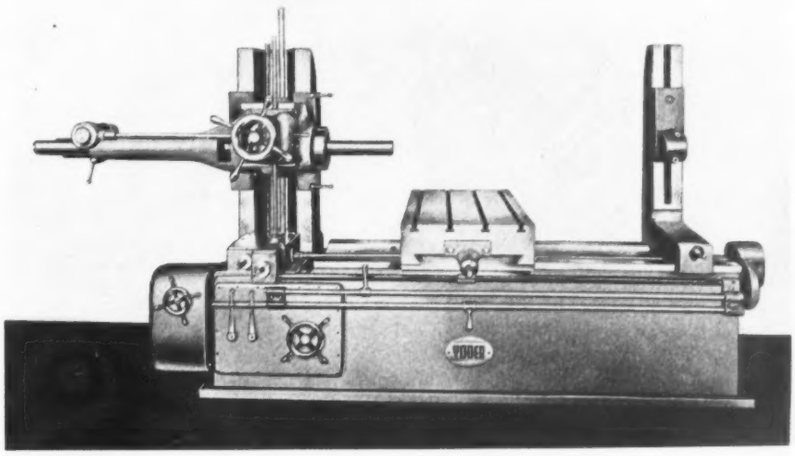
A tailstock turret known as the "Quadruplex," which is designed for use in engine or turret lathes, has been brought out by the Specialties Mfg. Co., Inc., 35 Farrand St., Bloomfield, N. J. This turret provides four positions for tools having shanks 5/8 inch in diameter, and is regularly made with a No. 2 Morse taper shank, although other shanks can be furnished to order. It has been developed to increase the productivity of any bench or floor type engine lathe. Applied to a turret lathe, it permits four operations to be performed in one position of the turret.

Simply releasing the clamp handle and pressing down on the index handle permits a tool to be turned into position for use, after which the clamping handle can be tightened to hold the tool rigidly in place. 69

Yoder Horizontal Boring Mill

A new horizontal boring mill of improved Lambert design has been placed on the market by the Yoder Company, W. 55th St. and Walworth Ave., Cleveland, Ohio. The spindle drive of this machine is by means of a hardened and ground multiple-thread worm on a vertical shaft which drives a heavy worm-gear on the spindle. The spindle bar does not revolve in bearings, but slides in carefully fitted ways. Ball bearings of the thrust type are used to reduce any strain on the feed mechanism. No change-gears are incorporated in the head, and the consequent reduction in weight has made it possible to dispense with the usual cable and counterweight. The outer support is equipped with vernier scales which are matched with vernier scales on the head and column to facilitate setting up.

A quick-change gear-box with back-gears gives a total of sixteen speeds ranging from 8 to 380 R.P.M. Sixteen power feeds are obtainable for the head, saddle, and table in each direction. Eight feed changes are made by means of a handwheel on the front of the feed-box, and eight additional feeds are obtained with the back-gear. A power-driven rapid traverse is provided for up and down movement of the head, lateral movement of the saddle, and back-



Improved Horizontal Boring Mill Placed on the Market by the Yoder Company

To obtain additional information on equipment described on this page, see lower part of page 188.

ward and forward movement of the table. The multiple-disk clutch for starting, stopping, and reversing the spindle is controlled by a bar running along the front of the machine, which is equipped with a sliding handle. A similar bar is used to start, stop, and reverse the feed.

The spindle bar has a traverse of 24 inches. The head can be lowered until the center of the spindle is 1 inch above the top of the table or raised until the spindle is 30 inches above the table. The longitudinal travel of the table on the bed, with power feed, is 52 inches, while the maximum distance from faceplate to outer support is 72 inches. 70

Hannifin Improved Tool-Room Machine

The improved No. 10 tool-room machine, a general-purpose unit built by the Hannifin Mfg. Co., 621-631 S. Kolmar Ave., Chicago, Ill., now includes a precision thread-cutting lathe with power longitudinal feed of the compound slide. The quick-change gear-box of this feed permits cutting forty-five thread pitches ranging from 4 to 120 threads per inch and furnishes sixty-three feed changes ranging from 0.250 to 0.0021 inch per revolution. The compound slide has rapid adjustment clamping features and ground adjustable take-up gibs. The toolpost rest is graduated, allowing accurate settings up to 60 degrees either side of the center, and the feed-screw handles have adjustable micrometer dials.

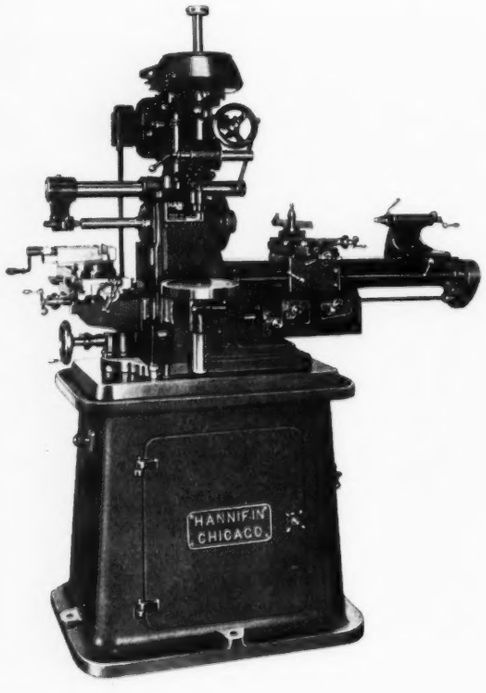
The lathe is driven by a reversible 1-H.P., 1725-R.P.M. motor, and twelve spindle speeds from 85 to 1250 R.P.M. are obtainable. The lathe spindle is mounted in preloaded ball bearings, and will take adapters having a B & S No. 10 taper shank.

This machine also performs the functions of a sensitive drill press, horizontal milling machine, and vertical machine, as outlined in a description of the earlier model, which appeared in June, 1940, MACHINERY, page 151. 71

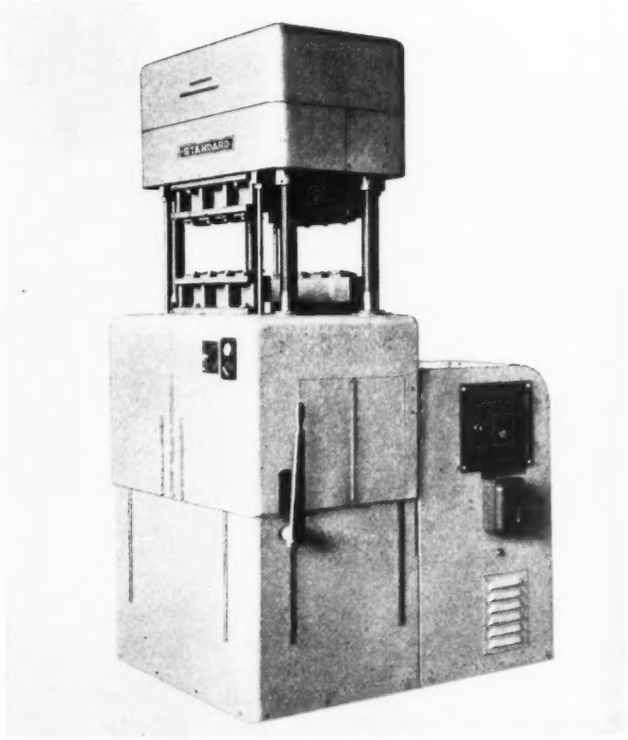
Semi-Automatic Molding Press with Closing Speed Control

"Standard" semi-automatic molding presses in both conventional and streamline models, with a new "slow-closing" control feature, are being placed on the market by the F. J. Stokes Machine Co., Plastics Division, 5930 Tabor Road, Philadelphia, Pa. By means of this new control, the final closing of the mold under compression can be accurately timed for from one second to twenty minutes, as desired. The closing speed is timed automatically and duplicated exactly in each cycle. This control of the speed during the final closing is said to permit the use of less expensive flash type molds in cases where they would otherwise be impracticable. It is also claimed that savings in materials, as high, in some instances, as 20 per cent, have been made possible by this control.

The control mechanism enables the press to be operated automatically, except for the actual loading of the mold and the removal of the finished pieces. Thus, the closing, preheating, breathing, pressure, and length of cure are not dependent on the judgment of the press operator. The control adjustments are simple, and can be set so that the slow-closing action starts at any desired point in the ram travel. The speed can be adjusted while the ram is in motion. With this controlled action, rejects are said to be reduced to a minimum in molding precision parts or parts containing delicate inserts or thick and thin sections. 72

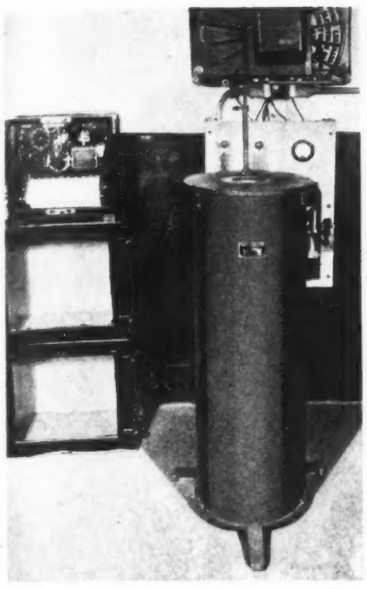


Improved Tool-room Machine Brought out by Hannifin Mfg. Co.



Stokes Semi-automatic Molding Machine with Closing Speed Control

To obtain additional information on equipment described on this page, see lower part of page 188.



Improved Thermo-couple Testing Furnace

Leeds & Northrup Thermo-Couple Checking Furnace

The thermo-couple checking furnace made by the Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa., has recently been redesigned to permit checking thermo-couples more accurately and over a wider range of temperatures. The improved equipment consists essentially of a small electric furnace, which provides a zone of practically uniform temperature for the intercomparison of laboratory standard couples and for the comparison of laboratory standard and plant standard couples.

A new accessory is a cylindrical copper equalizing block that fits inside the furnace. Drilled into this block are five wells for holding the comparison standard and the four couples that are to be checked. With the equalizing block, checks can be made within plus or minus 1 degree F. from room temperature up to 1000 degrees F. Without this block, checks can be made within plus or minus 3 degrees F. over a range of 300 to 1800 degrees F.

The furnace is available with heating elements for either alternating- or direct-current operation on 115 or 230 volts. It requires an input of from 40 watts at 300 degrees F. up to 1000 watts at 1800 degrees F. When the temperature must be raised rapidly, the input can be increased to 5000 watts. The working space inside the furnace is 4 inches in diameter by 36 inches deep. The outside diameter is 14 1/4 inches. 73

Sundstrand Automatic Lathe Equipped for Finish-Turning Three Sizes of Shells

The Sundstrand Machine Tool Co., 2530 Eleventh St., Rockford, Ill., recently built a Model 12 automatic stub lathe for finish-turning the bodies of 75-millimeter, 90-millimeter, and 3-inch anti-aircraft shells. The tooling was made as universal as possible, so that the machine can be easily changed to handle any one of the three sizes of shells. As shown in the illustration, the machine is equipped with the regular longitudinal front carriage and a cross-feeding rear tool-slide.

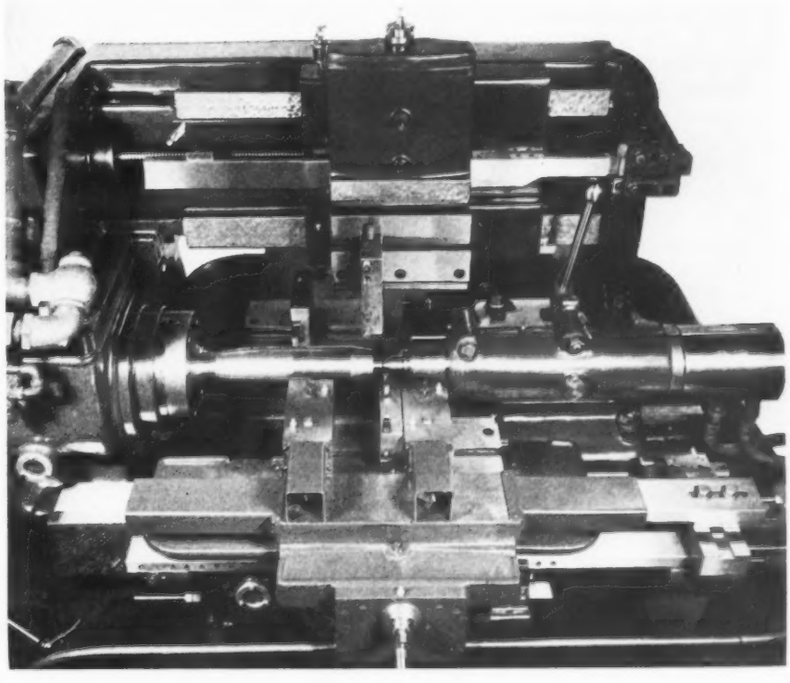
An outstanding feature of this machine is the semi-standard longitudinal feeding third, or overhead, tool-slide provided to take an extra cut on the bourrelet diameter. This overhead tool-slide can be either disconnected or removed entirely, or by changing the top slide can be converted to an auxiliary facing slide in the event that the machine is to be used for other types of work.

After the work is loaded into the machine, an automatic cycle provides for rapid approach, feed, rapid return and stop. These operations are timed and interlocked with the starting and stopping of the machine spindle and the flow of coolant. The shell is held and driven by an air-operated expanding type driver in the bore of the open end, and is supported at the outer end by the tailstock center, which is moved into and out of position by compressed air in order to simplify the loading and unloading operations.

Two cam-bar controlled tool-blocks and one straight turning tool-block for finish-turning the irregular contour of the shell are attached to the front tool-slide. One tool, which faces the edge of the shoulder at the end of the bourrelet diameter, is held on the cross-feeding rear tool-slide. The bourrelet diameter receives an extra cut from the tool carried on the longitudinal feeding overhead slide. The turning tools for both the overhead and the front slide are provided with automatic tool relief.

Tungsten-carbide tipped tools are employed at a speed of 454 R.P.M. and a feed of 0.020 inch per revolution, giving a floor-to-floor machining time of 0.83 minute, or a regular production rate of 60 pieces per hour for the 75-millimeter shell.

Tungsten-carbide tipped tools are also employed in the set-up for machining the 90-millimeter shells. The machining speed employed on this shell is 400 R.P.M., with a feed of 0.020 inch per revolution. The floor-to-floor time on the 90-millimeter



Sundstrand Model 12 Automatic Stub Lathe, with Lubricant Nozzle and Hood Removed to Show Tool Equipment Employed for Machining Operations on 75-millimeter Shells

To obtain additional information on equipment described on this page, see lower part of page 188.

shell is 1.04 minutes, which gives a regular production rate of 49 pieces per hour.

Tungsten-carbide tipped tools are used in turning the 3-inch anti-aircraft shell, employing a speed of 454 R.P.M., with a feed of 0.020 inch per revolution. The floor-to-floor time for this size shell is 0.65 minute, and the production rate 78 pieces per hour. 74

Modern Tool Works Collapsible Taps

The ability to tap threads close to the bottom of a hole with standard chasers is one of the advantages claimed for a line of collapsible taps recently developed by the Modern Tool Works, Rochester, N. Y. These new collapsible taps, which were shown at the recent Machine and Tool Progress Exhibition in Detroit, are made with a one-piece body and have a solid end. No end plate or cap is required with this construction, and regular chasers extend beyond the tap body, thus permitting close-to-bottom tapping.

This design also adds to the rigidity and strength of the tap, prevents the chaser slots from spreading, and holds the chasers securely and accurately in position. The tap collapsing action is positive, and always takes place at the same point, being effected by an adjustable hardened-steel trip plate which comes in contact with the work, causing the chasers to collapse quickly and leave the threads clean and unmutilated. The chasers are set at an angle, and can be easily removed by taking out one screw. Provision is made for adjusting the tap to cut over- or under-size threads.

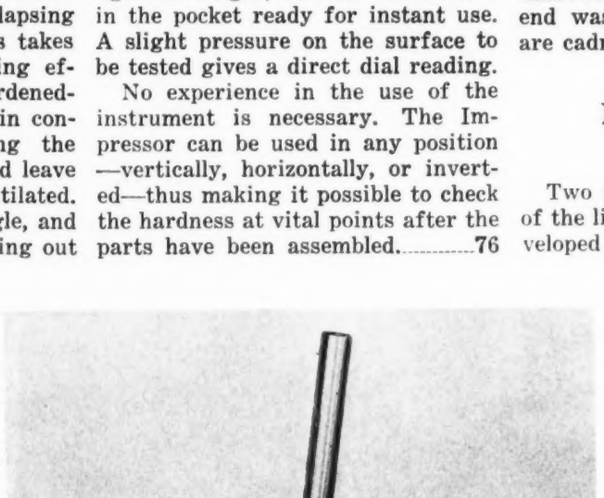
The stationary type tap, shown in the illustration, is fitted with a handle for resetting after collapsing, whereas the rotary type has a sleeve for this purpose. The stationary type can be easily converted to the rotary type by removing the handle and replacing it with the sleeve. Collapsible taps are regularly made by this company in twelve sizes, covering a range of thread sizes from 13/16 inch to 3 1/4 inches in diameter, each size having a liberal range of threading capacity. 75

Barber-Colman Hardness Tester for Soft Metals

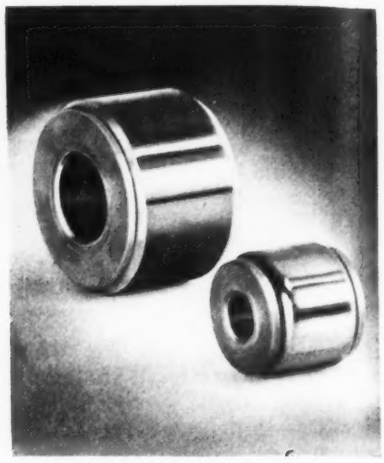
"Impressor" for Testing Hardness of Aluminum

An accurate hardness tester for aluminum alloys or similar soft metals, plastics, hard rubber, etc., has been brought out by the Barber-Colman Co., 203 Loomis St., Rockford, Ill. This instrument, known as the "Impressor," will permit testing the hardness of finished parts of almost any size or shape. It is small, light in weight, and can be carried in the pocket ready for instant use. A slight pressure on the surface to be tested gives a direct dial reading.

No experience in the use of the instrument is necessary. The Impressor can be used in any position —vertically, horizontally, or inverted—thus making it possible to check the hardness at vital points after the parts have been assembled. 76



Stationary Type Collapsible Tap Made by Modern Tool Works



Torrington Needle Bearings for Aircraft Applications

Torrington Needle Bearings for Aircraft Applications

A number of new needle bearing assemblies especially intended for aircraft service have been announced by the Torrington Co., Torrington, Conn. The bearings are made in two series, designated the AR series for normal service, and the AT series for heavy duty. The bearings in both of these new series are provided with inner races and permanently attached end washers. All exposed surfaces are cadmium-plated. 77

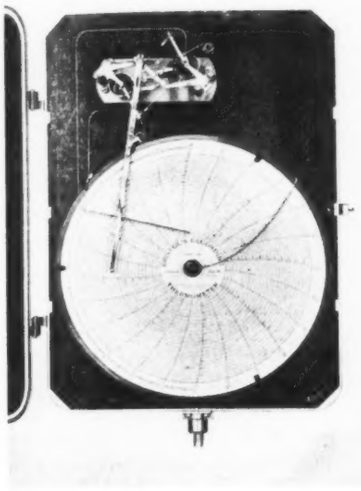
Bristol Recording Thermometers

Two new recording thermometers of the liquid-filled type have been developed by the Bristol Co., Waterbury, Conn. One type is known as the "Case-Compensated Class I" recording thermometer, and the other as the "Fully Compensated Class I" recording thermometer.

The Case-Compensated instrument is offered in temperature ranges up to 400 degrees F. and in tubing lengths up to 10 feet or longer, depending on conditions surrounding the installation. The Fully Compensated thermometer may be had in ranges up to 400 degrees F. equipped with 200 feet, or less, of connecting tubing between the instrument and the bulb.

The improved design and construction of the

To obtain additional information on equipment described on this page, see lower part of page 188.



Bristol Recording Thermometer of Liquid-filled Type

Bruning "Volumatic" Print Developer

Linde Hand Truck for Welding Equipment

measuring elements, tubing, and bulbs in these instruments extend the field of application of the liquid-filled thermometer, making it possible to take advantage of the desirable characteristics of the Class I thermometer system in a greater variety of temperature measuring applications. 78

Bruning High-Speed Print Developer

A BW developing machine designed for faster print production has just been brought out by Charles Bruning Co., Inc., 100 Reade St., New York City. This machine — the No. 159 "Volumatic" developer—is designed for use with the Bruning Model No. 75 BW printer. Using this new combination, one operator can easily and quickly perform the entire printing and developing operation.

The sensitized paper and tracings are fed into the printing unit, at the front, where they are immediately exposed. A vacuum separator roll at the discharge point of the printer separates the tracings from the exposed prints, allowing the prints to pass automatically to the developing and drying unit. The tracing is returned to the operator, while the completely developed print is delivered flat and dry at the rear of the machine. The developing section is driven by the printer, and is synchronized to operate at the same speeds. 79

Linde Welding Cylinder Truck

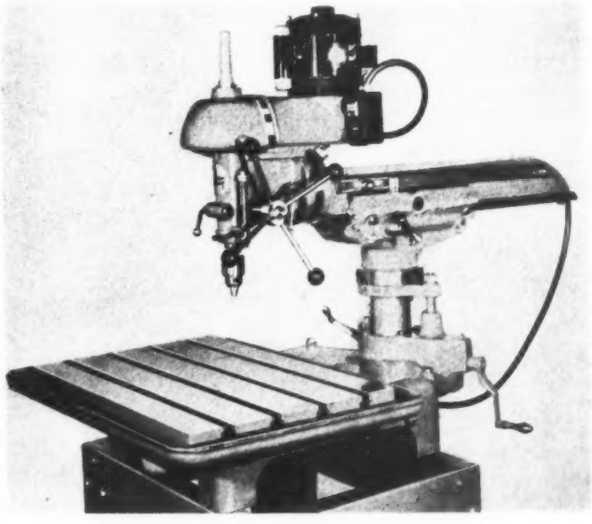
A hand truck designed to carry an oxygen cylinder, an acetylene cylinder, and a complete welding and cutting outfit has just been placed on the market by The Linde Air Products Co., Unit of Union Carbide and Carbon Corporation, 30 E. 42nd St., New York City.

This truck, known as the Oxweld T-7 two-wheel welding truck, has 14-inch wheels equipped with semi-pneumatic rubber tires, is of a well-balanced design, and weighs considerably less than the all-steel wheel trucks which it replaces. The overall width of the new design has been reduced 4 1/2 inches to permit passage through narrower openings. 80

Walker-Turner Light-Duty Radial Drill

A low-cost radial drill for performing light-duty operations has recently been placed on the market by the Walker-Turner Co., Inc., 602 Berckman St., Plainfield, N. J. The drill head of this machine is mounted on a heavy cast-iron ram which rides back and forth in a supporting cradle on eight precision ball bearings, and is quickly locked in any desired position. The drill head, ram, and cradle swing easily to the right or left on a machined collar mounted on the top of the raising and lowering column, and are raised and lowered by a crank-operated screw mechanism mounted on the side of the supporting column. The drill head can be tilted to any angle up to 45 degrees either to the right or left.

This machine will drill to the center of a 62-inch circle. The ram travel is 18 inches, and the maximum distance from chuck to table is 13 1/2 inches. The vertical move-



Radial Drill for Light-duty Operations, Made by Walker-Turner Co., Inc.

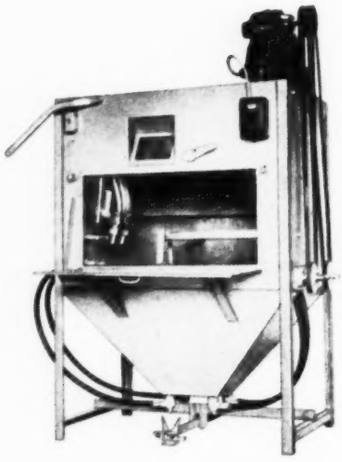
To obtain additional information on equipment described on this page, see lower part of page 188.

ment of the drill head is 8 1/2 inches, and the spindle travel 3 3/4 inches. The capacity of the Jacobs chuck is 1/2 inch. The over-all height of the machine is 72 inches, width 31 inches, and depth 58 inches. 81

Leiman Automatic Cabinet Sand Blast

A four-nozzle type of automatic cabinet sand blast has been designed by Leiman Bros., Inc., 101H4 Christie St., Newark, N. J., for cleaning or finishing the inside and outside of tubing or solid pieces of work. This cabinet sand blast is equipped with two rotating fixtures for holding and turning the work-pieces. The vertical nozzles travel longitudinally to clean or finish the outside surface of the revolving pieces, while the side nozzles are used for cleaning the inside of any article which may be hollow. The rotating fixtures are motor-driven, but may be arranged for hand manipulation if desired.

The machine is entirely self-contained; the sand placed in the lower tapered section is automatically fed to the nozzles by means of air pressure, and after discharging, drops to the bottom of the machine for re-use. A foot-lever controls the flow of sand. Another lever is provided for raising and lowering the nozzles to cover the work surfaces. During operation, when the door is closed, the progress of the work may be readily observed through a glass window. The machine is suitable for a wide variety of work on metal, glass, and plastics. It occupies a floor space of 36 by 48 inches.....82



Automatic Cabinet Type Sand Blast Brought out by Leiman Bros., Inc.

Brown Flexible Program Control System

A completely flexible program control system using Brown potentiometer controllers has been placed on the market by the Brown Instrument Co., Wayne and Roberts Aves., Philadelphia, Pa. This system is particularly adapted for use in the steel and metal industries, where completely automatic control can be applied to such heat-treating processes as annealing, normalizing, carburizing, and stress relieving, as well as many special applications requiring automatic control systems.

This program control system provides a means for maintaining a constant rate of temperature rise over a given period, a constant temperature during one or more periods, and a constant rate of temperature decline over a given period. The timer can be set for any period in minutes or hours, depending upon the range selected, and almost any control sequence desired can be obtained.

Some of the advantages of the new system are easy adjustment, elimination of cams which need to be cut or changed for different programs, and provision against obtaining false chart records. Several multiple-zone furnaces can be controlled from one master program system. 84

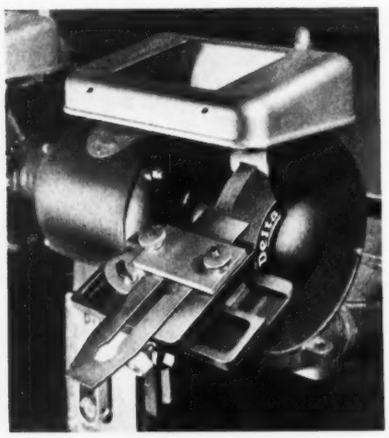


Fig. 1. Delta Plane-bit Grinding Attachment

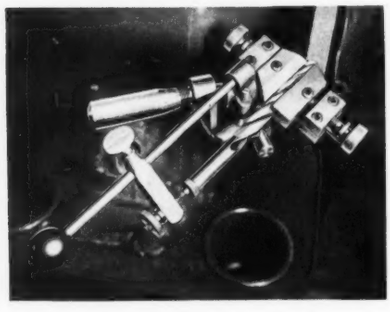
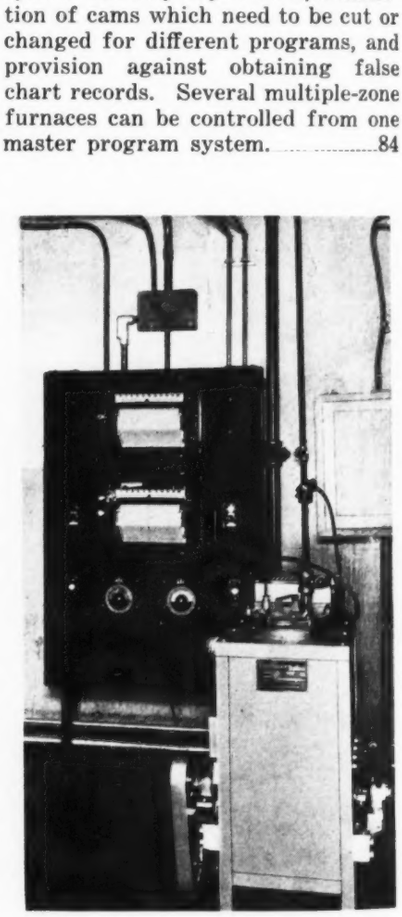


Fig. 2. Delta Drill-grinding Attachment

Delta Grinding Machine Attachments

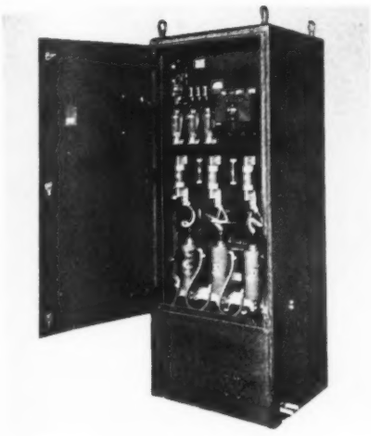
Two grinding attachments have recently been placed on the market by the Delta Mfg. Co., 660 E. Vienna Ave., Milwaukee, Wis. One of these is a plane-bit grinding attachment, which is readily clamped to the adjustable arm on the grinder. The carriage table, to which the plane bit is clamped, as shown in Fig. 1, tilts so that the desired grinding angle is obtained, and an adjustable quadrant located on the left side facilitates the accurate grinding of angle knives, as well as those with square cutting edges. A knurled-nut feed provides a fine adjustment for the amount of cut when grinding. The distance between the clamp screws is 3 3/16 inches, affording ample space for wide knives, as well as scrapers.

The other attachment is used for grinding drills, which are firmly clamped as shown in Fig. 2. A setting attachment with micrometer type adjustment insures accurate positioning of the drill to secure evenly ground lips. This attachment will handle 1/8- to 5/8-inch drills. 83



Brown Program Control System Installed on Heat-treating Furnace with Repeating Control Cycle

To obtain additional information on equipment described on this page, see lower part of page 188.



Westinghouse Ignitron Rectifier for Spot-welders

Westinghouse Rectifier for Spot-Welders

An Ignitron rectifier designed especially for supplying direct current to magnetic energy-storage type spot-welders, such as are used for joining aluminum in the aircraft industry, has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The new rectifiers are available in two capacities, one for use with 40-kilowatt, and the other with 120-kilowatt spot-welders. Each rectifier will operate two welders if the sequence is so arranged that only one can be loaded on the rectifier at a time.

The rectifier consists of a control and protective panel, power transformer, and Ignitron power tubes, all contained in a force-ventilated, floor-mounted, sheet-metal cabinet with a heavy welded-base frame. The tubes are arranged for water cooling, controlled by a thermostatic water-flow switch. The control and protective panel is located in the top of the cabinet, and the Ignitron assembly is at the bottom.

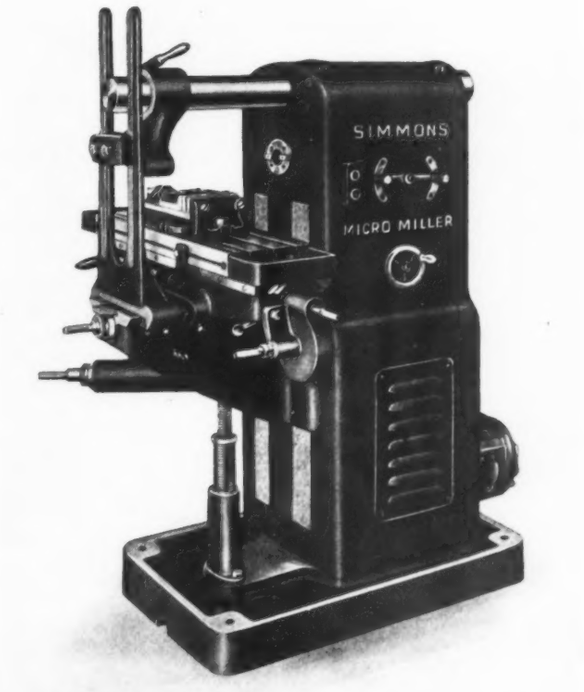
Hinged doors provide access to the front of the cabinet, and the back can be removed for servicing. A 14-inch fan, driven by a 1/8-H.P. motor, cools the transformer, the cooling air being exhausted through a grille located at the rear of the cabinet. 85

Simmons Micro-Miller

The Simmons Machine Tool Corporation, 1600 Broadway, Albony, N. Y., has brought out a new milling machine which is adapted for the rapid handling of small parts. It has been especially designed for use in plants manufacturing small firearms and airplane parts, as well as for tool-room repair shops and any plants producing small parts in quantity. It is also adaptable for use in training schools.

This machine, known as the Simmons No. A-1 Micro-Miller, is equipped with the Simmons Microspeed drive, a variable-speed unit that has been successfully employed in the new turret lathe and standard heavy-duty engine lathes made by the same company. The drive is mounted inside the machine column, and is provided with handwheel control.

The working surface of the table is 27 by 8 inches. The longitudinal power feed is 34 inches; the cross-feed, 8 inches; and the vertical feed of the knee, 18 inches. The spindle speeds range from 38 to 500 R.P.M., and the table feeds from 0.007 to 0.100 inch per revolution of the spindle. The machine weighs approximately 2400 pounds and requires a floor space about 64 by 46 inches. 86



Simmons Micro-Miller Designed for the Rapid Milling of Small Parts

"Red Streak" Hand Lift Truck Built by Yale & Towne Mfg. Co.

Improved "Red Streak" Hand Lift Truck

An improved hand lift truck operating on the lever and fulcrum principle, which is capable of handling 3500-pound loads, has been developed by the Yale & Towne Mfg. Co., 4530 Tacony Ave., Philadelphia, Pa. This new single-stroke lift truck, known as the "Red Streak," has fewer moving parts than previous models, and has safety features designed to prevent accidental tripping. The compound articulated lift mechanism has increased the lifting ratio, so that less operating effort is required.

New features include a balanced handle with a smooth chromium finish, and a handle-balancing mechanism enclosed in the tubular handle shaft, which keeps the handle in an upright position. The truck has a 90-degree lift and a full 180-degree steering movement. All wheels are steel, with smooth machined faces, and are mounted on ball bearings that are sealed to protect them from dirt. This truck is available in either wide- or narrow-frame models. 87

Handy Lamp Socket for Machine Illumination

A lamp socket known as the "Swivelier" has been placed on the market by the Reliance Devices Co.,

To obtain additional information on equipment described on this page, see lower part of page 188.

140 Liberty St., New York City. The features claimed for this lamp socket are that it is adjustable to a 90-degree angle; that it can be rotated in a complete 360-degree circle, when adjusted at any angle; that the wires cannot twist because of the construction; that the unit will stay "put" in any position; that vibrations will not cause the swivel to work loose; that a strong spring compensates for wear due to friction; and that there are no exposed wires. It is stated that the lamp has been approved by the Underwriters' Laboratories. 88

Torches for Removing Risers from Metal Castings

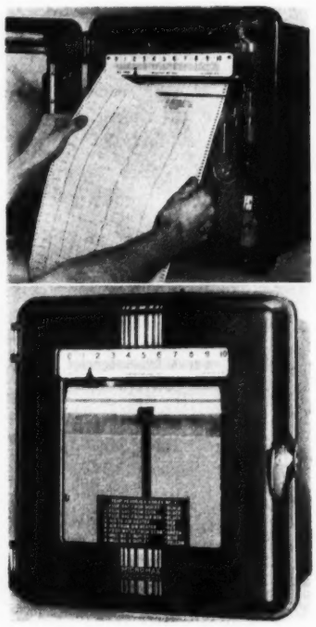
In response to a demand for greater convenience in removing riser heads from metal castings, Air Reduction, 60 E. 42nd St., New York City, has introduced a new line of hand-cutting apparatus consisting of two torches and three tips. The new torches are of the straight-head type, both having Monel metal heads and stainless-steel tubes to insure longer life. Each torch is 21 inches in length. The cutting oxygen can be controlled by either a lever or a trigger. The type of control selected can be placed at either side or at the top or bottom of the torch to suit the convenience of the operator.

The new cutting tips are made in three styles—one being bent to an angle of 75 degrees, another to an angle of 90 degrees, while the third (not shown) is a straight tip 7 inches long. These tips are designed to facilitate use in restricted areas, such as are frequently encountered in riser cutting. While designed especially for cutting risers, this new apparatus is also adapted for removing rivets, for construction and repair work in shipyards, and for regular applications. 89

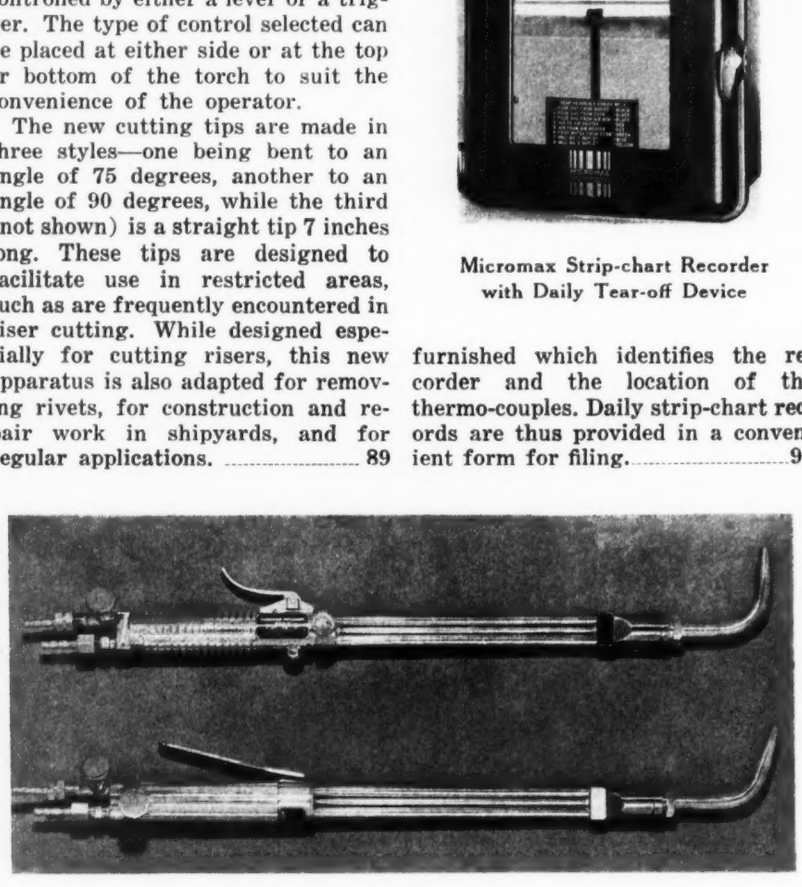
Tear-Off Device for Micromax Recorders

A new device that enables users of Micromax strip-chart recorders to tear off and file a record after each day's operation, has been brought out by the Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa. The device can be quickly and easily applied to the modern standard Micromax recorders.

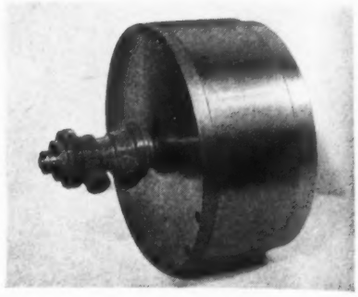
With this device, no part of the chart is wasted and it is not necessary to rethread the chart through the guides. A rubber stamp can be furnished which identifies the recorder and the location of the thermo-couples. Daily strip-chart records are thus provided in a convenient form for filing. 90



Micromax Strip-chart Recorder with Daily Tear-off Device



Air Reduction Torches for Cutting Risers



"Airgrip" Revolving Chuck-operating Air Cylinder

"Airgrip" Ball-Bearing Revolving Air Cylinders

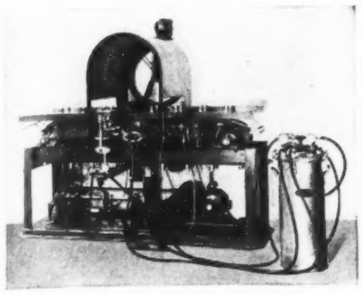
No manual adjustment of packings is required in the new Model D ball-bearing "Airgrip" revolving air cylinders brought out by the Airgrip Chuck Division of the Anker-Holth Mfg. Co., Inc., Port Huron, Mich., to conform to specifications approved by the American Standards Association. These chuck-operating cylinders are so designed that all wear is automatically taken up by the air pressure within the cylinder. The cylinder is designed to run for years under average conditions without attention. The graphite-treated piston packing has a covered wire in each strand to insure long life.

The air pressure on the "airshaft packings" in each air inlet is balanced; consequently, there is no end thrust and the entire air connection can be freely revolved around the airshaft with the full pressure in the cylinder. The air-inlet body has a long bearing of small diameter, and has ball bearings at both ends to reduce friction to a minimum and permit the cylinder to run at higher speeds. A semi-finished adapter and an "Airgrip" operating valve are furnished with each cylinder. These cylinders are made in sizes from 3 to 20 inches in diameter. The revolving cylinders are also made with a hole through the center to permit feeding bar stock through the spindle of the machine. 91

Eclipse Sprayer for Coating Inside of Artillery Shells

An automatic machine designed to spray the inner surfaces of projectiles has been brought out by the Eclipse Air Brush Co., Inc., 400 Park Ave., Newark, N. J. The machine illustrated has a capacity for spraying the inside of 155-millimeter shells at the rate of 500 an hour. Machines of this type can also be built to

To obtain additional information on equipment described on this page, see lower part of page 188.



Eclipse Automatic Sprayer for Applying Coating to Inner Surfaces of Projectiles

handle any size projectiles or cylindrical objects.

The shells are picked up from the conveyor belt by metal arms, and carried along in a horizontal position on the machine to a point in front of an automatic spray gun fitted with an extension nozzle. A master switch trips the trigger on the spray gun as it starts to move forward, and a rotating device with which the spray gun is synchronized spins the shell to insure an even coating. As soon as the spray nozzle has withdrawn from the projectile, the shell moves along, making room for the next one. When the sprayed shell reaches the end of the machine, the metal arms deposit it, still in a horizontal position, on another conveyor belt. 92

Metallizing Spray Gun

A new metallizing spray gun (Type 2E) has been placed on the market by the Metallizing Engineering Co., Inc., 21-07 41st Ave., Long Island City, N. Y. Two improvements in this gun are a controlled power unit, which gives a uniform and steady wire feed for production service, eliminating the need for gear changes; and a universal gas head, which allows the use of acetylene, propane, hydrogen, natural, or manufactured gas with balanced pressures.

The controlled power unit regulates the rate of wire feed by means of a governor operating on the power-absorption principle, thus allowing full power input at all times and eliminating speed fluctuations under varying loads. In addition, this gun is claimed to have improved spraying characteristics, so that extremely fine coatings are obtainable at production speeds, and this, combined with simplified adjustments, permits continuous operation with maintained speed and quality. An improved nozzle and jet construction

Metco Metallizing Gun, Made by Metallizing Engineering Co., Inc.

tends to reduce gas consumption. The maximum air pressure required is 65 pounds per square inch. The entire unit weighs only 4 3/4 pounds. 93

Black & Decker Portable Electric Drill

A 1/4-inch, standard, portable electric drill that is particularly adapted for aircraft work has been developed by the Black & Decker Mfg. Co.,

Black & Decker Portable Electric Drill Equipped with Anti-friction Bearings

Towson, Md. It is equipped throughout with anti-friction bearings, and has a splined gear mounting, locked inner and outer races on the spindle bearing, and a removable end cover.

This drill has a close offset, and can be obtained with either an end or side handle. Its drilling capacity is 1/4 inch in steel, and 1/2 inch in hard wood. The drill is regularly provided for operation at 2000 R.P.M., but it is also available with speeds of 3500 and 5000 R.P.M. 94

Federal Gage for Checking Lands and Grooves in Gun-Barrel Bores

A gage for checking the land and groove diameters of gun barrels, which can be applied to small pistols and rifles, as well as large artillery guns, has been developed by the Federal Products Corporation, 1144 Eddy St., Providence, R. I. The view to the right in the illustration shows the Model G3F P-28 gage inserted in a 37-millimeter anti-aircraft gun. The insert view to the left shows the head of the gage, which consists of three sensitive contact points and three guide points.

The entire gaging head is free to revolve, so that as the guide points move down the grooves of the barrel

Gage for Checking Gun Barrel Lands and Grooves, Made by Federal Products Corporation

To obtain additional information on equipment described on this page, see lower part of page 188.

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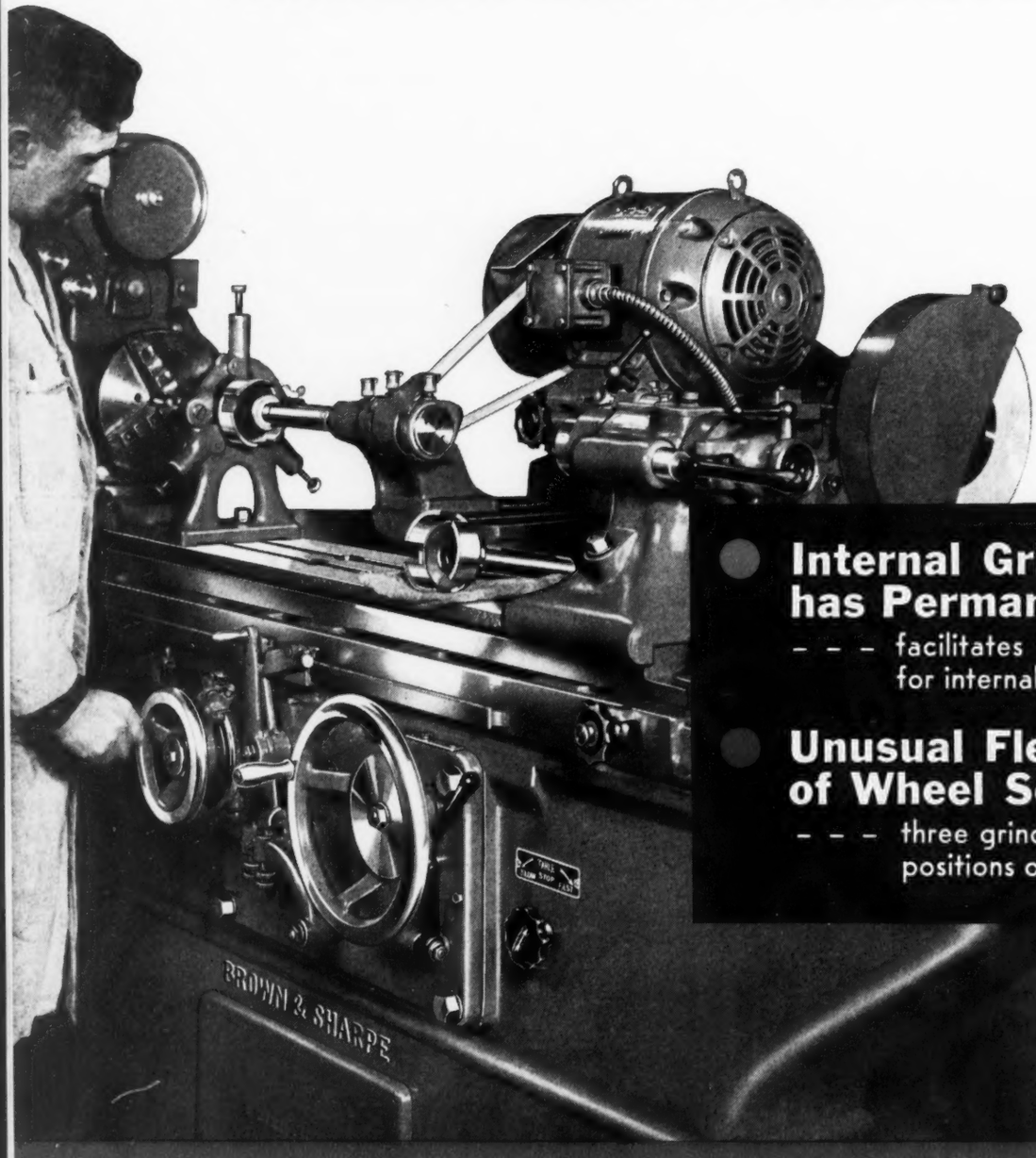

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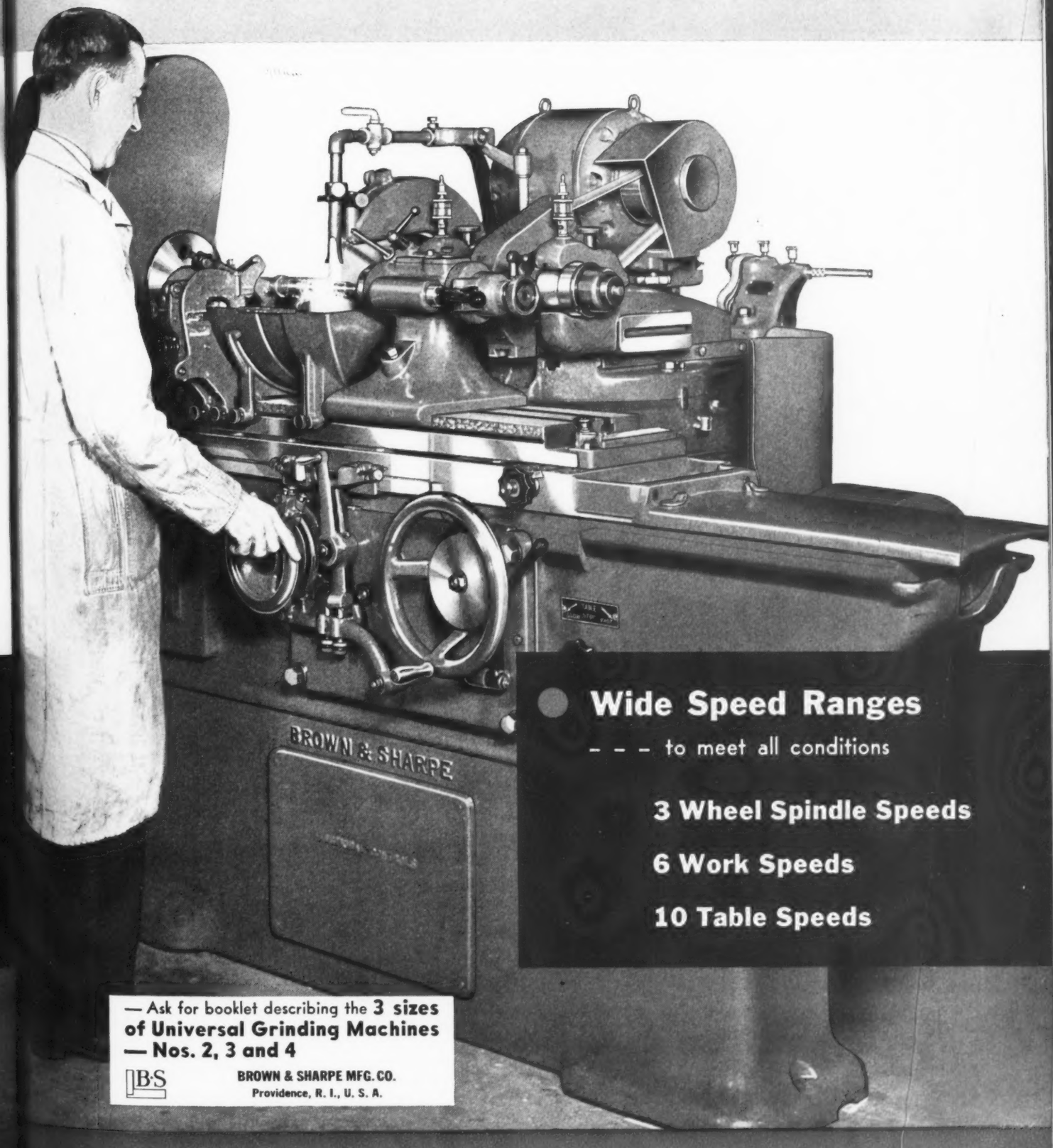

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– – – to meet all conditions

3 Wheel Spindle Speeds

6 Work Speeds

10 Table Speeds

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Providence, R. I., U. S. A.

SHARPE

the head rotates, permitting the contact points to follow the grooves for checking the diameter, out-of-roundness, and taper. The lands of the gun barrel can also be checked in the same way. The guide points prevent the contact points from slipping off the lands into the grooves. At intermediate points, depending upon the length of the barrel, wooden supporting collars are employed to keep the gage in alignment and yet allow the required amount of float.

The barrel of the gage is graduated in inches, so that the inspector can determine at any time the exact point being gaged. The gaging points are contracted by simply pulling on the trigger beneath the dial indicator. 35

Delta Multi-speed Attachment for Drill Presses

Delta Multi-Speed Attachment for Drill Presses

A new attachment for 14-inch drill presses has been developed by the Delta Mfg. Co., 660 E. Vienna Ave., Milwaukee, Wis. This attachment provides a wide range of speeds for both the high-speed and slow-speed models. It consists of a heavy casting, which is mounted on the top of the drill press column, together with a cone pulley and two belts. The belt slack is taken up by rotating the casting about an offset pivot. A range of twelve speeds is available through the various pulley combinations. The grease-sealed ball-bearing pulley used in the assembly insures smooth, vibrationless operation. 96

B & S Motor-Driven Centrifugal Pumps

The Brown & Sharpe Mfg. Co., Providence, R. I., has recently added to its line two new motor-driven centrifugal pumps — the No. 225, shown in Fig. 1, and the No. 245, shown in Fig. 2. These pumps are suitable for supplying coolant to machine tools, and are especially applicable where dirt or abrasives may be present in the liquid and where a large-volume delivery at a low head is required.

Fig. 1. Brown & Sharpe No. 225 Motor-driven Centrifugal Pump

They are of compact design, the one shown in Fig. 1 having a foot type motor bracket, the motor and pump unit being closely coupled. The discharge port can be located at any 90-degree position with respect to the motor by shifting the pump assembly on the motor end bell.

The pump shown in Fig. 2 is also a close-coupled unit, and has the flange mounting integral with the pump, so that the unit does not require inlet piping. The discharge port of this pump can be shifted to any 45-degree angle with respect to the intake or suction port. The entire pump assembly can also be located at any 90-degree position with respect to the motor.

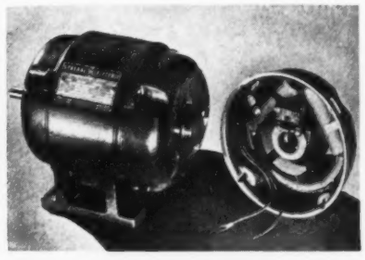
These pumps are designed for operation with the impeller below the liquid level, and can be mounted in practically any position, horizontal or vertical. It is preferable, however, that the motor should not be located below the pump. These pumps are furnished with 1/2-H.P. motors, and will handle from 55 gallons per minute at a 10-foot total head up to 20 gallons per minute at a head of 22 1/2 feet. 97

Fig. 2. B & S Close-coupled No. 245 Motor-driven Pump

"Tri-Clad" Capacitor Motor

As an extension of its recently announced line of polyphase induction motors, the General Electric Co., Schenectady, N. Y., has brought out a new "Tri-Clad" capacitor motor designed to meet a wide variety of industrial applications. Like the polyphase "Tri-Clad" motor, this capacitor motor has been modernized in appearance and designed to provide better mechanical and electrical protection, as well as longer life. It is available with either ball-bearing or sleeve-bearing construction, and is made in two types.

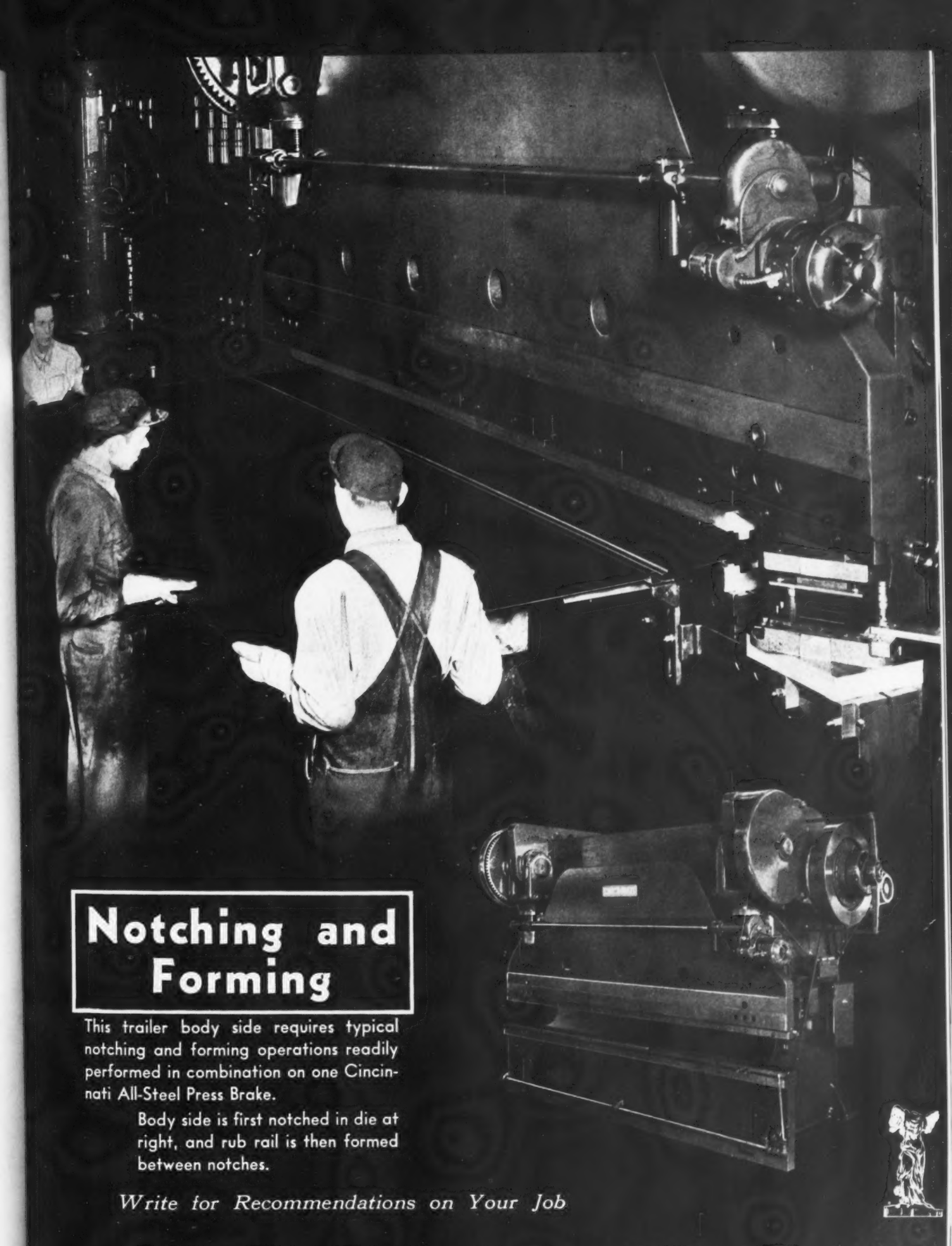
The Type KC motor is designed particularly for driving equipment requiring moderate starting torques, such as fans, blowers, and centrifugal pumps. The Type KCJ motor is designed for driving compressors, loaded conveyors, reciprocating pumps, and any other equipment requiring high starting torque. The capacitors are mounted inside the end shield on the normal-torque motor, while on the high starting torque motors of 1 1/2 H.P. and larger, the capacitors are mounted in a compact case on top of the motor frame.



Tri-Clad Motor with End Shield at Right Removed to Show Capacitors and Transfer Switch

Mechanical protection is obtained through the use of a cast-iron frame, and electrical protection by the use of Formex wire in the magnetic coils. Improved bearing design and lubricating arrangements are provided. Cast-aluminum rotor and double-end ventilation are also employed. The switch that transfers the motor connections from the starting to the running position consists of a centrifugal mechanism mounted on the rotor shaft and a stationary switch located in the end

To obtain additional information on equipment described on this page, see lower part of page 188.



Notching and Forming

This trailer body side requires typical notching and forming operations readily performed in combination on one Cincinnati All-Steel Press Brake.

Body side is first notched in die at right, and rub rail is then formed between notches.

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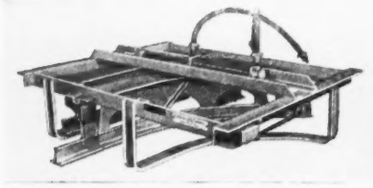
shield. As the motor approaches full speed, centrifugal force moves the collar of the rotating mechanism away from the switch by snap action, causing the switch to open. 98



Air-operated Switch for Tramrail System

Air-Operated Switch for Tramrail Systems

A new air-operated switch has been developed by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, for use on cab-operated, gravity, or automatic dispatch overhead materials-handling systems. This development enables the tramrail operator to save time by presetting the switch at some distance ahead of the functioning point while traveling. Indexes on gravity or automatic dispatch carriers can also be set to actuate trippers which will cause one or several switches to take up the desired positions.

The switch is ruggedly built of welded-steel construction. It consists of two main assemblies — an outer supporting frame and an inner sliding frame. The outer frame is designed to be bolted rigidly to the superstructure. The inner assembly, carrying a straight and a curved rail, rides on multiple rollers, and is set in position by an air cylinder. Systems employing Cleveland tramrail air-operated switches are available in capacities up to 5 tons. 99

"Nonslip Rubberpull" Pulley Coating

The Nonslip Pulley Covering Co., 777 Hertel Ave., Buffalo, N. Y., has recently developed a product known as "Nonslip Rubberpull." It is supplied in liquid form, and is readily applied by a brush to the face of any flat or V-type pulley for the purpose of preventing belt slippage. The product has a rubber base, and is so compounded that it adheres firmly to the pulley face under heavy loads. Considerable increase in the efficiency of belt drives has been noted in tests of this compound. 100

Machine Tool Electrification Forum to be Held by Westinghouse

The principal feature of the 1941 Machine Tool Electrification Forum to be held April 14 to 16, inclusive, at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., will be a discussion of production and design problems created by the national defense emergency in the machine tool industry. Howard Dunbar, vice-president of the Norton Co., and a member of the Machine Tool Division of the National Defense Advisory Committee, will outline the production problems of national defense and the responsibilities of the machine tool industry.

Design and electrical apparatus considerations for gun-boring lathes will be discussed by G. A. Spohn, electrical engineer of the General Machinery Corporation. J. R. Weaver, manager of the Louisville Ordnance Division of the Westinghouse Electric & Mfg. Co., will speak on Westinghouse activities in national defense.

R. H. Clark, electrical engineer for the Warner & Swasey Co., will describe prefabricated wiring methods for machine tools, and Philip McKenna, president of the McKenna Metals Co., will discuss metal-cutting carbide tools. Among the subjects to be discussed by Westinghouse engineers are comparative methods of dynamic balanced measurement; features of the new smaller 203-225 frame motors; and plant distribution circuits. Visits will be made to different sections of the East Pittsburgh Works.

Procedure for Cleaning Brass, Copper, and Zinc Alloys before Plating

A new procedure designed especially for cleaning brass, copper, and zinc alloys before plating has been developed by Oakite Products, Inc., 26 Thames St., New York City. This procedure insures complete removal of oil, grease, soap films, and other deposits, and assures better plate adhesion. It consists of three principal steps: (1) Effective precleaning of work, either with an emulsifying solvent or an alkaline compound, depending upon the condition and shape of the work; (2) anodic cleaning with an alkaline electro-cleaner designed especially for the purpose; and (3) sulphuric acid dip. The work is rinsed, of course, following each operation.

In addition to removing foreign matter more completely than has been possible with the cleaning methods that have been generally used in the past, this new process is said to prevent formation of soap films when the cleaner becomes contaminated with soap. Complete information on the new process is made available in a booklet published by Oakite Products, Inc.

Summer Management Course Offered by the University of Iowa

The State University of Iowa, Iowa City, Iowa, is offering for the third consecutive summer a special three-week course for people in industry interested in production planning, motion and time study, and related subjects. The course will be held from June 9 to 27. It will be under the direction of Ralph M. Barnes, professor of industrial engineering at the University. Assisting him there will be six university instructors and eight visiting managers and engineers from industry, who will conduct forums on practical production problems.

The course is planned for people from industry who wish to obtain practical training in cost reduction methods, as well as for those who want to conduct training programs in this field for members of their own organizations. During the present emergency, the principles and techniques to be presented in this course should be of especial value to those concerned in carrying out the National Defense Program.

To obtain additional information on equipment described on this page, see lower part of page 188.

MINE MAINTENANCE

WITH A SUPER SERVICE RADIAL

Today in many large plants the Maintenance Shop is one of the most important and vital departments. Nothing less than the most dependable, most versatile tools can be tolerated in such shops.

The above photograph shows one of the three Super Service Radial Drills in the **Underground Maintenance Shop** of a large mine where they are relied upon for a variety of metal drilling operations.

These machines have a wide range of speeds and feeds, long-lived accuracy and features for fast, easy operation. The distinctive features of the Super Service Radial Drills are explained in Bulletin R-24. Write for it today.

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A.S.M.E. National Defense Production Meeting

THE third meeting on armament production sponsored by the American Society of Mechanical Engineers and the Army Ordnance Association was held at the Hotel Statler, Cleveland, Ohio, March 12 and 13, with about 250 manufacturers, engineers, and Army and Navy officers participating. The keynote of the meeting was "Engineers against Time," and the papers and discussions dealt primarily with how to expedite the conversion of peacetime manufacturing plants to war-work uses.

Seven separate sessions were held. One of these was concerned with the speeding up of tank manufacture. At this session, Frederick A. Stevenson, vice-president in charge of operations, American Car & Foundry Co., New York City, read a paper on "Building Combat Tanks for the U. S. Army," which was illustrated with lantern slides showing the performance of the important operations in tank construction.

Ammunition Manufacture

Two sessions were held on shell and ammunition manufacture. At one of these, George T. Trundle, Jr., president of the Trundle Engineering Co., Cleveland, Ohio, read a paper on "Improvised Methods for Rapid Munitions Manufacture" that stimulated much discussion. In this paper, Mr. Trundle emphasized the importance of getting production under way with present equipment until the latest types of high-production machines and other manufacturing facilities become available. It was pointed out in the discussion that perhaps as much as 50 per cent of our present machine tool equipment is not being operated to its full capacity. Existing machines are generally capable of much greater speeds and feeds than those at which they are ordinarily operated, except in outstanding production shops.

It was brought out that the lack of gages (and gage-makers) constitutes a serious drawback; but it was also emphasized that with a little ingenuity and imagination, the engineer can improvise temporary gages to meet the needs until the best types of manufactured gages become available. Our engineers are so used to working with high-grade, properly adapted equipment that they have lost, in some degree, the ability of the old-time engineer and mechanic to produce results with makeshift tools and methods. At the present time, in order not to hold back production, such tools and methods become of great value and importance.

At the second session on ammunition manufacture, Max Kronenberg, of the Cincinnati Milling Machine Co., Cincinnati, Ohio, read a paper entitled "Coordination of Speed, Feed, Depth of Cut, Horsepower, Tool, and Tool Life for Maximum Shell Production." This paper made available charts for rapidly determining the best combination of production factors for obtaining maximum output and tool life. At this session, high-speed cutting tools and their characteristics were also discussed.

Gaging Practices Discussed

At a session on Gaging Practices, three papers were presented. S. B. Terry, chief engineer of the gage department of the Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., read a paper on "Modern Gaging Practice." This was followed by a paper on "Gaging Operations in Shell Manufacture," read by Fay Aller, chief engineer of the gage and machine tool division of the Sheffield Gage Corporation, Dayton, Ohio. Finally, Elmer J. Bryant, of the gage division, Army and Navy Munitions Board, Washington, D. C., in a paper entitled "Gage Supply," dealt with the prospects for obtaining the required gaging equipment.

Aviation manufacture was discussed in a session at which Arvid Nelson, factory manager of the Hamilton Standard Propellers Division of the United Aircraft Corporation, read a paper on "Planning for Accelerated Production." This paper was well illustrated with lantern slides and motion pictures.

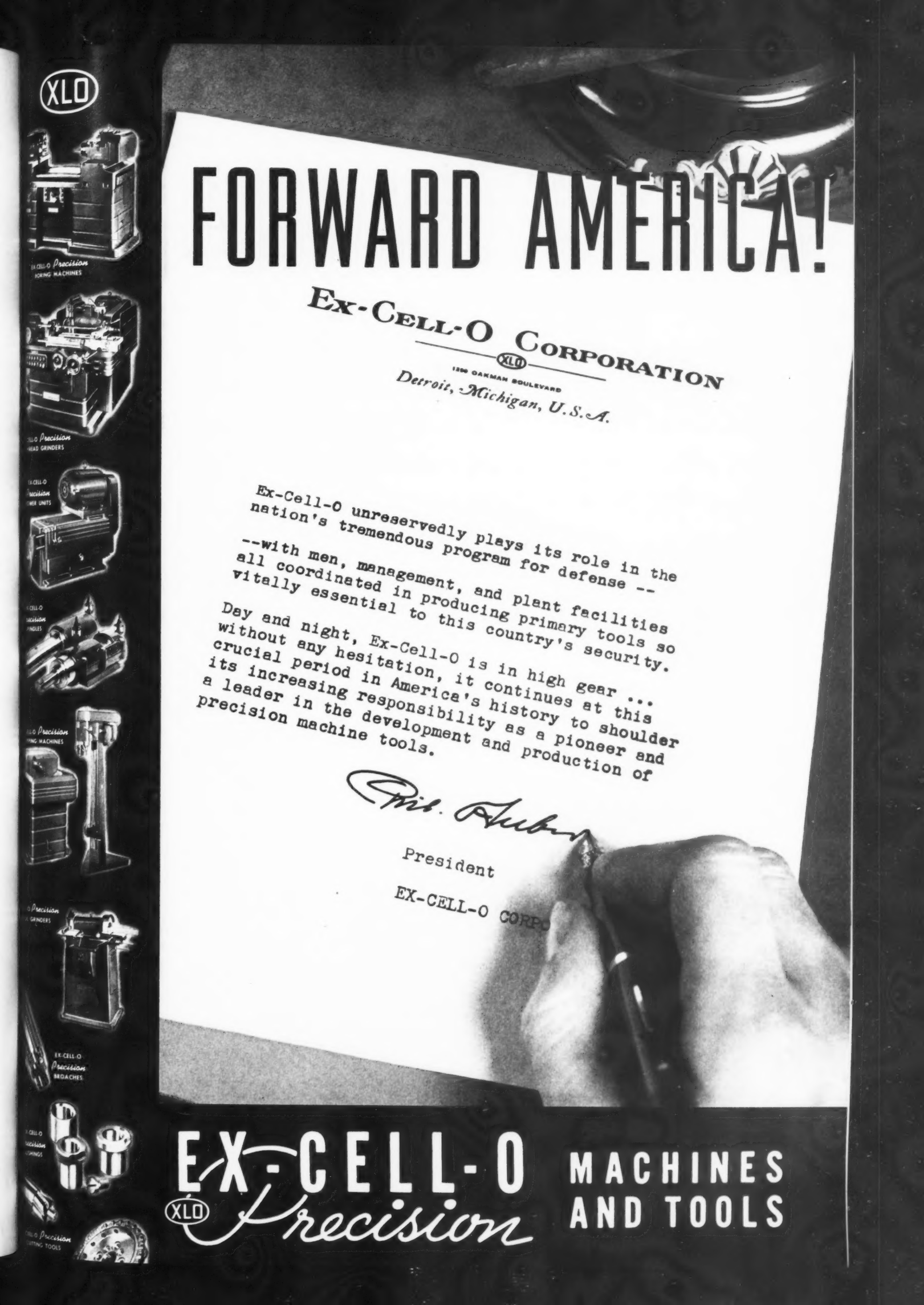
Industrial Training

A session that brought out many important facts was that on Training of Industrial Personnel. Three papers were read, one on "Connecticut Training Program and Results," by Dr. Alonzo Grace, commissioner of education of the state of Connecticut; another on "Organizing Intensive Job Instruction," by Michael Kane of the Training within Industry Division of the Advisory Commission of the Council on National Defense, Washington, D. C.; and the third on "Training District Ordnance Inspectors," by Lieutenant B. P. Shirey, Training Officer, Frankford Arsenal, Philadelphia, Pa.

In the discussion of industrial training programs, the important fact was brought out that some of the provisions of the Wages and Hours Act actually hamper manufacturers in giving the required training to young men in the work for which they may become fitted. For example, if a manufacturer goes to the expense of organizing a training school, on the pattern of the accepted state training schools, he must not let the young men perform any useful production work in this training school; and if useful production work is performed, then it must be thrown away or destroyed — an astounding provision at a time when this country needs every possible addition to its productive capacity.

A session on "Subcontracting" created a great deal of interest and discussion. At this session, Robert L. Mehornay, Jr., Director of Defense Contracts Service, Washington, D. C., spoke on "Subcontracting in Defense Production," outlining how the production of urgently needed materials has been, and can further be, greatly accelerated by subcontracting to shops equipped to do certain work, although they may not be able to handle the entire contract.

At one of the luncheon meetings, Tell Berna, general manager of the National Machine Tool Builders' Association, made a stirring and informative address entitled "Machine Tools Against Time," in which he pointed out, among other things, the large number of machine tools required to supply a single gun with its ammunition. He made it clear that modern wars are fought as much by the machines and men in the factories at home as by the gallant soldiers, sailors, and marines in the front lines of action. All of which leads to the conclusion that anything that is done to stop or hold up production in armament plants today is as reprehensible as would be the desertion of the front-line trenches, and should be handled accordingly.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Detroit, Michigan, U.S.A.
Ex-Cell-O unreservedly plays its role in the nation's tremendous program for defense -- --with men, management, and plant facilities all coordinated in producing primary tools so vitally essential to this country's security.
Day and night, Ex-Cell-O is in high gear ... without any hesitation, it continues at this crucial period in America's history to shoulder its increasing responsibility as a pioneer and a leader in the development and production of precision machine tools.
President
EX-CELL-O CORP
EX-CELL-O
XLO
Precision
MACHINES
AND TOOLS

NEWS OF THE INDUSTRY

California

AXELSON MFG. CO., Boyle and Randolph Sts., Los Angeles, Calif., manufacturer of heavy-duty engine lathes and oil-well pumps, has completed the first step in its expansion plans, consisting of the removal of the engineering department from the General Administration Building to a newly finished structure which will be devoted to engineering department operations. The new building is 35 by 135 feet, and has a working space of 4720 square feet.

STEWART J. HIERONYMUS has been appointed sales engineer of the Lincoln Electric Co., Cleveland, Ohio, with headquarters at San Francisco, Calif. Prior to his appointment, Mr. Hieronymus was associated with Cutler-Hammer, Inc., for twelve years.

ALLEGHENY LUDLUM STEEL CORPORATION, Pittsburgh, Pa., announces that the company has recently completed a new warehouse and offices at 4915 Pacific Blvd., Los Angeles, Calif.

Illinois

TOOL EQUIPMENT SALES CO., 24 S. Pulaski Road, Chicago, Ill., has been appointed exclusive representative in the Chicago territory for the Lempco Products Co., manufacturer of grinding machines and hydraulic and electric arbor and straightening presses.

D. A. STUART OIL CO., 2727 S. Troy St., Chicago, Ill., is expanding its plant by the construction of a new two-story and basement addition. This will provide 3000 feet more of manufacturing space. The total investment will approximate $50,000.

H. W. MONS, vice-president of the Hill-Clarke Machinery Co., Chicago, Ill., received congratulations from his many friends all over the country on the occasion of completing, on March 31, his fortieth consecutive year with the company.

GARCY LIGHTING CO., 4224-46 Lincoln Ave., Chicago, Ill., has recently been organized to manufacture a line of industrial lighting units known under the trade name of "Vulcan."

J. B. COLE has been added to the sales staff of the Tool Equipment Sales Co., 24 S. Pulaski Road, Chicago, Ill. Mr. Cole was formerly connected with the Roth Mfg. Co., of Chicago.

Indiana

Announcement has recently been made of the amalgamation of the FOSTER MACHINE CO., of Elkhart, Ind., and the INTERNATIONAL MACHINE TOOL CO., of Indianapolis, Ind. The new corporation—the INTERNATIONAL MACHINE TOOL CORPORATION, Elkhart, Ind.—is engaged in the production of machine tools, including Libby turret lathes and Fastermatic automatic chucking lathes. The corporation is also licensed to manufacture Superfinish machines under the patents owned by the Chrysler Corporation. C. RUSSELL FELDMANN is president and treasurer of the new corporation. E. H. WELKER, who for the last twenty-five years has represented machine tool companies, including the Foster Machine Co., in Detroit, has been elected executive vice-president and a director. W. H. FOSTER, formerly president of the Foster Machine Co., is now chairman of the board of the new corporation. His nephew, CHARLES H. FOSTER, has been made assistant general manager, and E. J. TERRY, previously vice-president of the International Machine Tool Co., is vice-president and general manager of the new corporation. GEORGE M. SUNDHEIM, of the old International company, has also been made a director of the new corporation. The corporation has made arrangements to open a New York office in the Chrysler Building, 405 Lexington Ave., New York City.

VERNE E. MINICH, founder of the American Foundry Equipment Co., Mishawaka, Ind., and until recently its president, has been made chairman of the board. OTTO A. PFAFF, formerly vice-president and general manager, is now president and retains the position of general manager. LESLIE L. ANDRUS, formerly sales manager, has been promoted to the position of vice-president in charge of sales.

CUTLER-HAMMER, INC., manufacturer of electrical equipment, announces that the Indianapolis office of the concern has been moved to 241 N. Pennsylvania St., Room 316.

Michigan

CARBOLOY COMPANY, INC., Detroit, Mich., announces an expansion program which, when completed, will triple the company's carbide metal production capacity. The total increase in productive floor space will be approximately 23,000 square feet. The plant is operating at present on a three-shift basis, with part of the office personnel on a two-shift plan. Since the new Carboloy plant was completed in 1939, employment has approximately tripled in the shop alone.

PIONEER ENGINEERING & MFG. CO., Detroit, Mich., has just completed a new plant on John R. St. and State Fair Ave., covering 23,000 square feet of floor space, and located on a plot of ground of approximately five acres. The building is of highly modern construction, practically windowless, and equipped with fluorescent daylight lighting.

WELTRONIC CORPORATION, 3080 E. Outer Drive, Detroit, Mich., has recently completed a new plant, which is now in full operation, for manufacturing Weltronic controls for resistance welding.

New England

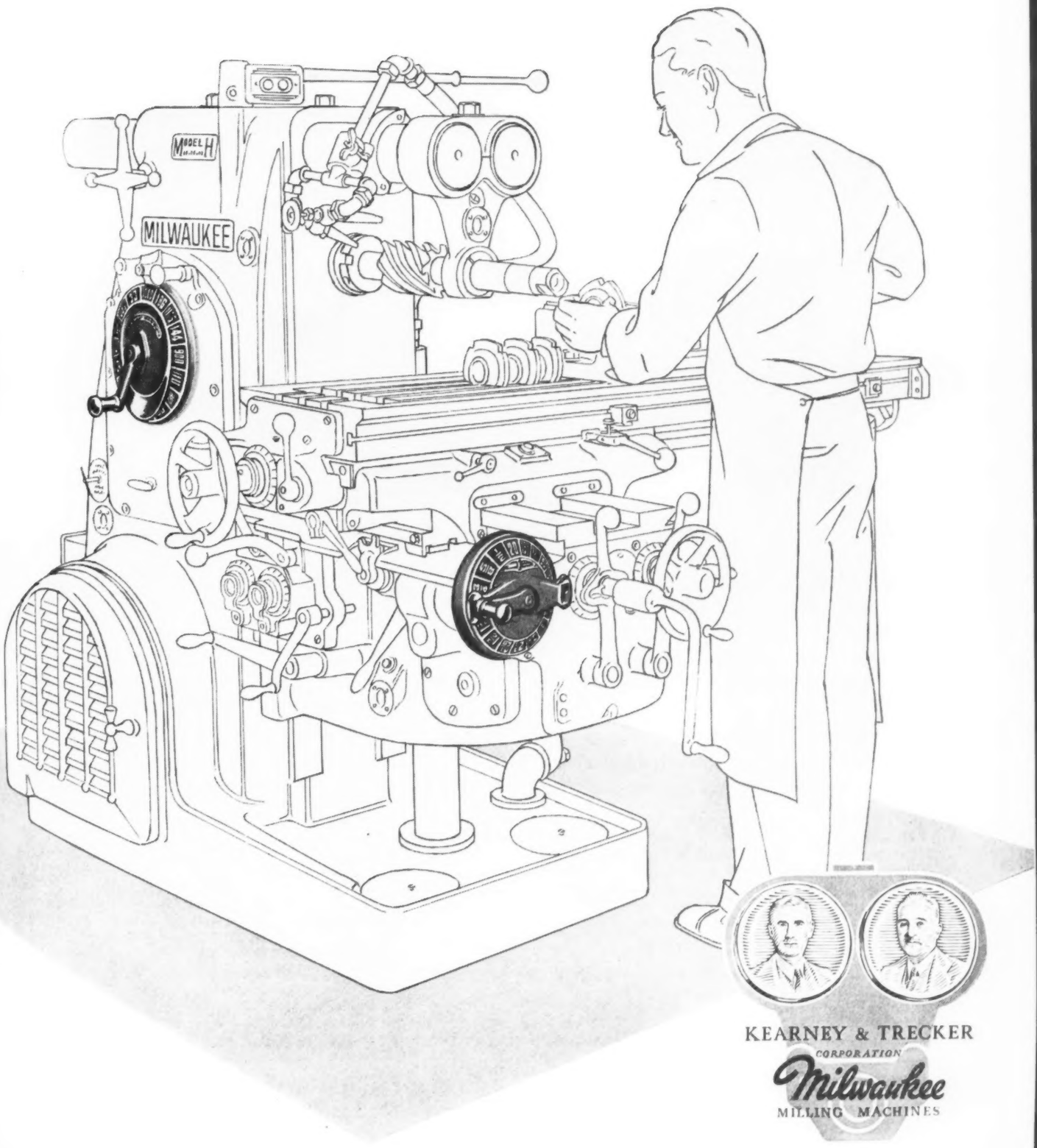
NORTON CO., Worcester, Mass., announces the following changes in its sales department: R. O. ANDERSON, who was previously district manager in Pittsburgh, has been transferred to Worcester, where he will report directly to W. R. MOORE, general sales manager. C. B. PRICE, formerly in the southeast section, has been made district manager at Pittsburgh. LORIN W. GRUBBS, who has been assisting Mr. Price in the eastern part of his section, will continue to serve that area, and ZACHARY M. ALMAND, formerly in the sales engineering department at Worcester, will take over the western part of that territory. G. T. TAYLOR has been transferred from the New York City area to the Chicago district; J. S. ANDERSON, from Pittsburgh to New York; and W. A. RUSSELL, field engineer in Pittsburgh, will take over Mr. Anderson's Pittsburgh sales territory. J. L. TOBEY, of the sales engineering department at Worcester, becomes field engineer at Pittsburgh. J. E. STRACHAN, JR., recently field engineer in New England, has been made a salesman in southern Ohio.

GENERAL ELECTRIC CO., Schenectady, N. Y., has recently completed plans for expanding its facilities for manufacturing plastic molded parts. The former motor plant of the company in Taunton, Mass., will be reopened and renovated for this purpose. This will be the fifth plant of the company devoted to the manufacture of plastics. Nearly three hundred molding presses of the compression type will be installed in the Taunton plant, and approximately four hundred persons will be employed there.

ADDISON C. ARMSTRONG has joined the Worthington Pump and Machinery Corporation at its Holyoke, Mass., Works as manager of the Ordnance Division. He was formerly connected with the Truscon Steel Co.

Single lever, direct reading, large diameter, easy-to-see speed and feed dials increase operator efficiency and reduce error.

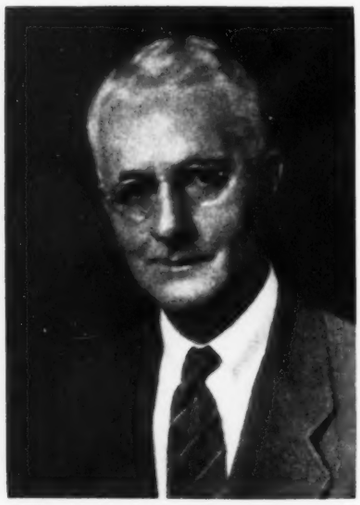
KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.



KEARNEY & TRECKER
CORPORATION
Milwaukee
MILLING MACHINES

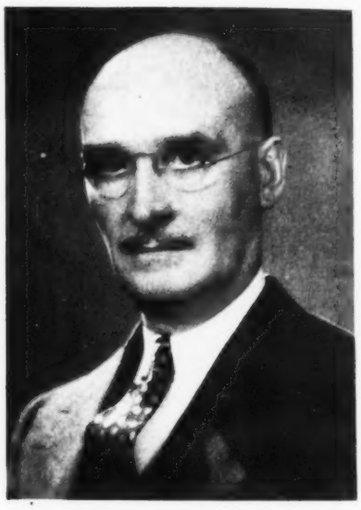
MILWAUKEE MILLING MACHINES

THOMAS E. DUNN, director and works manager of the Bullard Co., Bridgeport, Conn., has resigned on account of illness. He will be succeeded as works manager by FOSTER P. WHITWORTH. Mr. Dunn first entered the employ of the Bullard Co. in 1917 as night superintendent. At that time, the company was working on a United States Government contract for the manufacture of 155-millimeter field rifles. Following the Armistice and the completion of the war contract, Mr. Dunn, in recognition of the outstanding service rendered by him during the war days, was made assistant production manager of the Bullard Machine Tool Co. In 1921, he was advanced to the office of production manager, in 1922 was made assistant works manager, and a few years later assumed full responsibility as works manager. During this period, he was instrumental in the development of the Bullard-Dunn electro-chemical descaling process. In 1930, he was elected a director of the company.



Thomas E. Dunn, Who has Resigned as Works Manager of the Bullard Co.

Foster P. Whitworth, Who Succeeds Mr. Dunn as Works Manager of Bullard Co.



Raymond E. Christie, New Vice-president of Crucible Steel Co. of America

Mr. Whitworth first became connected with the Bullard Co. in 1896 as an apprentice. After working for three and a half years, he obtained a position as machinist with the American-British Co. In 1905, he returned to the employ of the Bullard Co. as a first-class machinist, and within two years was made assistant foreman in the lathe department. After holding various positions of increasing responsibility in the shop, he became, in 1928, assistant works manager, from which position he has been promoted to his present post as works manager.

AMERICAN MAGNESIUM CORPORATION, 230 Park Ave., New York City, has purchased four buildings and a tract of land from the Crane Co., at Bridgeport, Conn., for an immediate expansion of its facilities for producing magnesium castings for airplanes. This will add materially to the output of magnesium castings, which has already been stepped up by the corporation to twenty times the normal peacetime demand in 1938.

New Jersey

R. E. SPENCER GEARE is now connected with the Thermoid Rubber Division of the Thermoid Co., Trenton, N. J. Mr. Geare has specialized in the field of V-belt drives and power transmission for the last ten years.

INSTRUMENT SPECIALITIES CO., INC., manufacturer of beryllium copper springs, has recently moved from 379 Main St., Little Falls, N. J., into a two-story plant at 244-248 Bergen Blvd., West Paterson, N. J. The mail address remains Little Falls, N. J.

VINCENT J. RIORDAN has joined the Rawlplug Irvington Co., Irvington, N. J., as field engineer, covering the complete line of anchoring devices made by the Rawlplug Co., Inc., 98 Lafayette St., New York City.

New York

AMERICAN NICKEL ALLOY MFG. CORPORATION has been organized by the ANGLO-AMERICAN METAL & FERRO-ALLOY CORPORATION, with executive offices at 50 Church St., New York City, to engage in the manufacture of nickel alloys and allied products.

AIRCRAFT & ARMS PROCUREMENT CO., Chimes Bldg., Syracuse, N. Y., has been organized to bring together manufacturers having defense contracts and machine shops with enough space for subcontracting. The concern represents more than two hundred plants active in the National Defense Program, both in aircraft and armament work. The company has a catalogue available of plant facilities with a keyed index.

GENEVIEVE O. EDLUND was elected president of the Edlund Machinery Co., Inc., Cortland, N. Y., at the annual meeting of the company. E. A. DUNNING was made vice-president and general manager, and E. E. HEALEY, secretary-treasurer.

RAYMOND E. CHRISTIE was recently elected vice-president and a director of the Crucible Steel Co. of America, 405 Lexington Ave., New York City. Mr. Christie was previously assistant to the president, and has had a long and varied experience with the organization in branch and executive office positions.

Ohio

F. H. LINDUS, formerly Los Angeles branch manager in charge of the Service-Sales Division of the Timken Roller Bearing Co., has been transferred to the home office at Canton, Ohio, where he is engaged in general sales promotional work. L. J. HALDERMAN, branch manager of the Service-Sales Division of the Chicago office, has taken Mr. Lindus' place in Los Angeles, and will be succeeded at the Chicago office by JACK GELOMB, formerly Detroit manager of the Sales-Service Division. JOE JESSEPH, resident salesman in the Portland, Ore., branch, has taken Mr. Gelomb's place in the Detroit office.

DoAll SAVES $500

in three weeks

The American LaFrance Foamite Corporation, well-known makers of fire fighting equipment, Elmira, N.Y., kept a record during a 3-weeks' period of savings effected with one Model ML DoAll. Following are only a few of the jobs done—

	Old Method	*On DoAll*	*Saving*
No. 1	15 hours	5½ hours	9½ hours
No. 2	2½ hrs. each	½ hour each	2 hours each
No. 3	5 hours	1¼ hours	3¾ hours
No. 4	15 hours	2 hrs. 3 m n.	Almost 13 hrs.
No. 5	9 hours	2 hours	7 hours
No. 6	5 hours	¾ hour	4¼ hours
No. 7	12 hours	2 hours	10 hours
No. 8	12 hours	3 hours	9 hours
No. 9	1 hour each	¼ hour each	¾ hour each
No. 10	2 hours	⅛ hour	1⅛ hours

FREE — Literature and Handbook on Contour Machining, 158 pages of valuable metal working helps.

America's GREAT DEFENSE TOOL

BAND FILER

Does faster, better, smoother continuous filing on all materials from high - carbon steel to brass, wood, etc. Your choice of 21 styles of file bands, ½", ⅜" and ¼" wide, flat, oval or half round.

SPEEDMASTER

Provides every DoAll machine with instant variable speed—6 to 1 ratio. Also sold separately for use on any machine requiring variable speed. Ask for it.

The DoAll is the indispensable modern machine tool for speedy, accurate performance in handling scores of metal working jobs, formerly done on the shaper, lathe and milling machine. Now used in large and small plants everywhere to effect short cuts in making molds and dies, special tools and parts in the manufacture of armaments, motorized equipment, aeroplanes, battleship parts, etc.

Let us send a factory trained man to your plant to show you what a DoAll can do and save for you.

CONTINENTAL MACHINES, Inc.
1312 S. Washington Ave., Minneapolis, Minn.

T. I. Phillips, Assistant to the President of Westinghouse Electric & Mfg. Co.

R. E. Scott, formerly chief chemist of the Marlin-Rockwell Corporation, Jamestown, N. Y., has been added to the technical sales force, in the northern Ohio territory, of the Quaker Chemical Products Corporation, Conshohocken, Pa. He will make his headquarters at 320 Beech St., Berea, Ohio.

G & N Mfg. Co., 11610 Madison Ave., Cleveland, Ohio, maker of the G & N high-pressure, hydraulic die-casting machine, is opening a new machining and assembly plant in Bucyrus, Ohio, to meet the increasing demand for equipment built by the company.

Monarch Machine Tool Co., Sidney, Ohio, has just completed a $650,000 addition to its plant. The new plant began operating about the middle of March. The company's entire output is for purposes of national defense.

Pennsylvania

T. I. Phillips has been appointed assistant to the president of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Phillips was formerly general works manager, and will continue to be in charge of the headquarters manufacturing staff, the small motor, lighting, and transformer divisions, and the construction department of the company.

Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., manufacturer of Thor portable power tools, announces that the Philadelphia branch of the company has recently moved into a new buildng at the corner of 17th and Fairmount Aves., Philadelphia, Pa.

Ernest J. Poole, Jr., general superintendent of the Carpenter Steel Co., Reading, Pa., has been made vice-president in charge of manufacture, and Frank R. Palmer, assistant to the president, has been appointed vice-president in charge of sales.

Virginia

Foote Bros. Gear & Machine Corporation, 5301 S. Western Blvd., Chicago, Ill., has appointed Joseph S. Potts, Jr., of Jos. S. Potts, Jr. & Co., Travelers Bldg., Richmond, Va., representative of the company covering the state of Virginia.

Ernest J. Poole, Jr., Vice-president in Charge of Manufacture, Carpenter Steel Co.

Frank R. Palmer, Vice-president in Charge of Sales of the Carpenter Steel Co.

Wisconsin

J. C. Merwin, vice-president and treasurer of the Chain Belt Co., Milwaukee, Wis., was elected president of the company at the annual meeting of the board of directors, succeeding the late C. R. Messinger. Mr. Merwin joined the Chain Belt organization in 1917, and has been, successively, superintendent, works manager, assistant to president, director, vice-president, and treasurer.

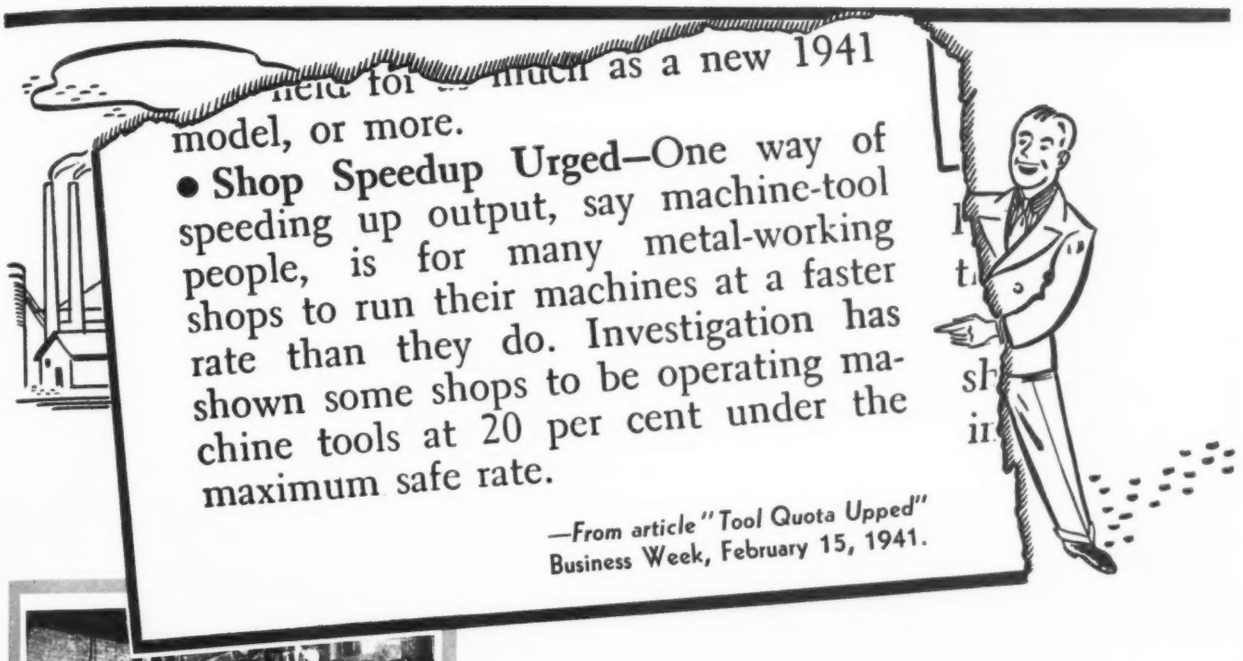
James M. White has been appointed assistant general works manager of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Mr. White was manager of the company's La Porte works for six years.

James M. White, Assistant General Works Manager of Allis-Chalmers Mfg. Co.

He originally became connected with the company in 1929, when he entered its graduate student engineering course as an apprentice.

A. E. Bateson, who until a year ago, was manager of purchases for the Allis-Chalmers Mfg. Co., Milwaukee, Wis., has retired from active service, after completing fifty years of association with the company. Mr. Bateson was born in England, and came to this country at the age of four. In 1891, he entered the employ of the purchasing department of Fraser & Chalmers, of Chicago, which was consolidated with the E. P. Allis Co. in 1901 to form the Allis-Chalmers Co. Mr. Bateson was succeeded in January, 1940, by F. E. Haker.

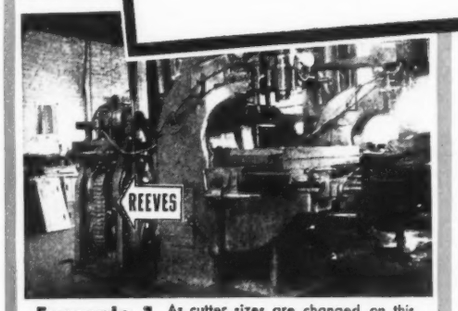
Clinton E. Swift has become associated with the Weldrod Division of Ampco Metal, Inc., 1745 S. 38th St., Milwaukee, Wis. He will head the development, production and distribution of "Ampco-Trode," a complete line of coated aluminum-bronze welding rods having the properties of Ampco Metal.



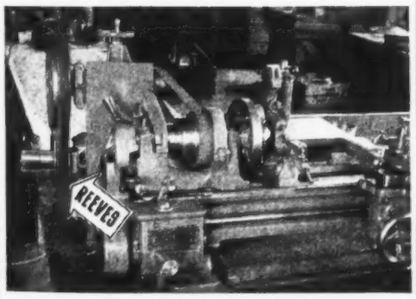
held for as much as a new 1941 model, or more.

● **Shop Speedup Urged**—One way of speeding up output, say machine-tool people, is for many metal-working shops to run their machines at a faster rate than they do. Investigation has shown some shops to be operating machine tools at 20 per cent under the maximum safe rate.

—*From article "Tool Quota Upped"*
Business Week, February 15, 1941.



Example 1 As cutter sizes are changed on this vertical milling machine, used for flat work milling, so are spindle speeds varied, thanks to the REEVES Transmission in connection with the change gear in the pulley at top of machine.



Example 2 Output on this bench lathe was speeded up by installing countershaft type REEVES Vari-Speed Motor Pulley to replace gear box and step-cone pulleys. Spindle speeds are adjustable over 3:1 ratio for a wide range of set-ups.

Example 3 In a Detroit machine tool shop, production on this lathe was increased by a full 25 per cent after application of a REEVES Vari-Speed Motodrive. Output speeds on the Motodrive range from 110 to 442 rpm.

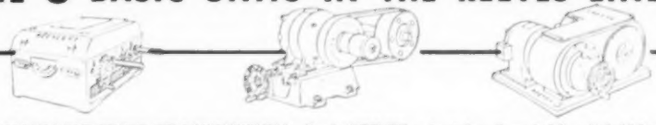
FASTER or SLOWER

–it's Easy with REEVES Variable Speed Control

There *is* a vital need for faster production, particularly in defense industries, *but faster machine speed is not always the answer.* It is *correct* speed, whether it be faster or slower, that turns out maximum quantity without rejects or spoilage. A REEVES Variable Speed drive permits operation at any speed that is best for the particular job. It enables operators to change speeds, almost instantaneously, as the work demands. It is accurate, positive and dependable. Many sizes of three basic units insure correct installations. Write for full information on how you can use REEVES Variable Speed Control units to speed up production and improve processing in your plant.

REEVES PULLEY COMPANY, Dept. M, COLUMBUS, INDIANA

THE 3 BASIC UNITS IN THE REEVES LINE

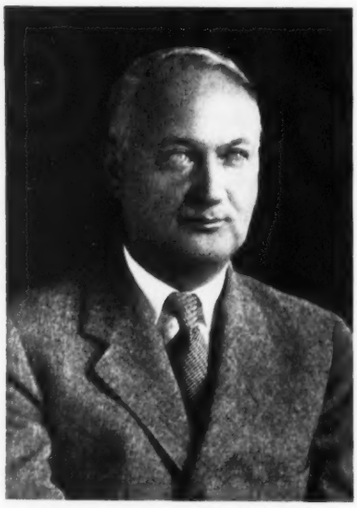


VARIABLE SPEED TRANSMISSION: Basic REEVES principle of variable pitch V-belt driving between two pairs adjustable cone-faced discs. **VARI-SPEED MOTOR PULLEY:** Forms direct drive from any constant speed motor to driven machine. **VARI-SPEED MOTODRIVE:** Combines constant speed driving motor, variable speed mechanism and (where required) gear reducer in a single compact unit.

OBITUARIES

Lewis E. Saunders

Lewis E. Saunders, a vice-president of the Norton Co., Worcester, Mass., and a pioneer in the development of electric furnace abrasives, died on February 20 after an illness of two weeks, at the age of sixty-seven. Mr. Saunders had been vice-president of the Norton Co. since 1937, and a director since 1921. In January, he gave up most of his active responsibilities, and had served since then as a consultant.



Lewis E. Saunders

Before joining the Norton Co., Mr. Saunders was associated in Ampere, N. J., with Charles B. Jacobs, who developed the process of making the aluminous abrasive known as Alundum. This product was acquired by the Norton Co. in 1900, and Mr. Saunders became connected with the company three years later. He served as chemical engineer, metallurgist, and superintendent of abrasive plants and research laboratories. Mr. Saunders had long been recognized as one of the nation's leading authorities on the electro-chemical production of abrasives. He was a member of the American Electrochemical Society, American Chemical Society, and the Society of Chemical Industry of Great Britain. He was a graduate of the University of Rochester, class of 1897.

WILLIAM B. UPDEGRAFF, an executive of the Watson-Stillman Co., Roselle, N. J., for twenty-five years, and an inventor of several important mechanical engineering devices, died on February 13 at the Harvard Club in New York City. Mr. Updegraff, a mechanical engineer, installed and operated the first marine turbine built in America. Among his inventions are the turbine clearance indicator, lead covering die-block for cable covering, and tunnel shield equipment for sub-aqueous tunnels.

R. M. SHEAK, a sales representative in the New York Division of the National Acme Co., Cleveland, Ohio, died suddenly at Elmira, N. Y., on February 21. Mr. Sheak will be greatly missed by his many friends in the National Acme organization, with whom he had been associated for seventeen years.

WILLIAM THOMAS, sales manager and assistant chief engineer of the Waterbury Tool Division of Vickers, Inc., Waterbury, Conn., died suddenly on February 17 at Waterbury.

COMING EVENTS

APRIL 1-3—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Atlanta, Ga. C. E. Davies, secretary, 29 W. 39th St., New York.

APRIL 14-16—MACHINE TOOL ELECTRIFICATION FORUM at the plant of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

APRIL 22-25—Twelfth annual SAFETY CONVENTION AND EXPOSITION of the Greater New York Safety Council at the Hotel Pennsylvania, New York City. For further information, address Greater New York Safety Council, Inc., 60 E. 42nd St., New York City.

APRIL 25-26—Twenty-first annual convention of the NEW JERSEY SOCIETY OF PROFESSIONAL ENGINEERS at the Hotel Traymore, Atlantic City, N. J.

MAY 5-7—Twenty-fifth annual convention of the AMERICAN GEAR MANUFACTURERS ASSOCIATION at the Homestead, Hot Springs, Va. J. C. McQuiston, secretary, 602 Shields Bldg., Wilkinsburg, Pa.

MAY 8-9—Forty-third annual convention of the NATIONAL METAL TRADES ASSOCIATION at the Palmer House, Chicago, Ill. Homer D. Sayre, commissioner, 122 S. Michigan Ave., Chicago, Ill.

MAY 12-15—Annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION at the Hotel Pennsylvania, New York City. C. E. Hoyt, executive secretary, 222 W. Adams St., Chicago, Ill.

MAY 19-23—WESTERN METAL CONGRESS AND EXPOSITION to be held in Los Angeles, Calif., under the auspices of the American Society for Metals. The Congress will have headquarters at the Biltmore Hotel, and the Exposition will be held in the Pan American Auditorium. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland, Ohio.

MAY 26-29—Twenty-sixth annual convention of the NATIONAL ASSOCIATION OF PURCHASING AGENTS at the Stevens Hotel, Chicago, Ill. For further information, address Wade R. Franklin & Associates, 205 W. Wacker Drive, Chicago, Ill.

JUNE 1-6—Summer meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbriar Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

JUNE 12-14—Thirteenth semi-annual meeting of the EASTERN PHOTOELASTICITY CONFERENCE at Cambridge, Mass., under the auspices of the Department of Mechanical Engineering at the Massachusetts Institute of Technology. Chairman of the local committee, W. M. Murray, Room 1-321, Massachusetts Institute of Technology, Cambridge, Mass.

JUNE 16-20—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Kansas City, Mo. C. E. Davies, secretary, 29 W. 39th St., New York City.

JUNE 23-27—Forty-fourth annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS to be held at the Palmer House, Chicago, Ill., in conjunction with an exhibit of testing apparatus and related equipment. For further information, address the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa.

OCTOBER 12-15—Fall meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at Louisville, Ky. C. E. Davies, secretary, 29 W. 39th St., New York City.

OCTOBER 20-24—Twenty-third NATIONAL METAL CONGRESS AND EXPOSITION to be held in Convention Hall and Commercial Museum, Philadelphia, Pa. Further information can be obtained from W. H. Eisenman, secretary, American Society for Metals, 7301 Euclid Ave., Cleveland, Ohio.

OCTOBER 30-NOVEMBER 1—National Aircraft Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Biltmore Hotel, Los Angeles, Calif. For further information, address John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

DECEMBER 1-5—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Astor, New York City. C. E. Davies, secretary, 29 W. 39th St., New York City.

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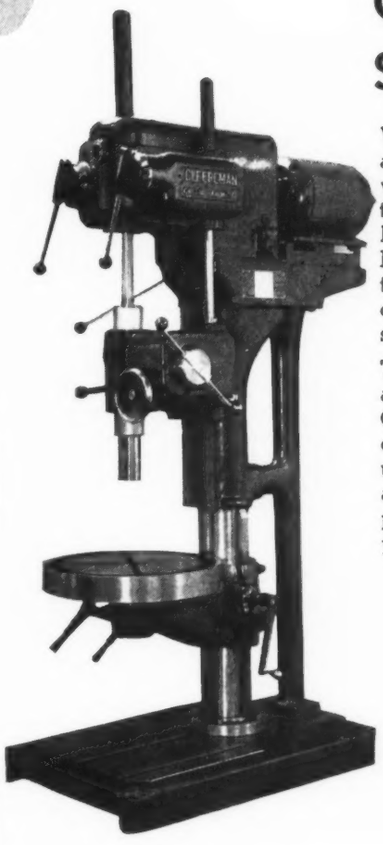

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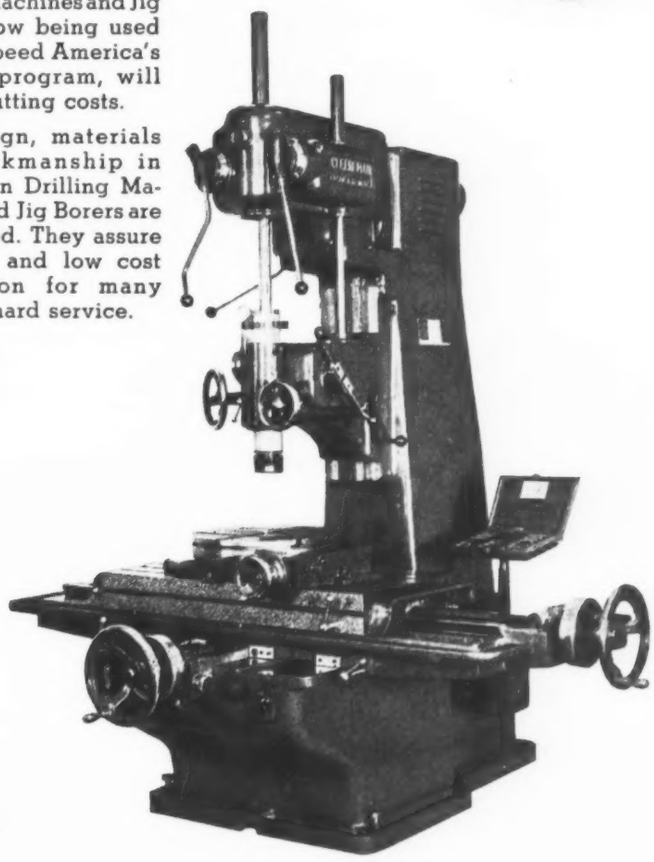

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NEW BOOKS AND PUBLICATIONS

THOMAS' REGISTER OF AMERICAN MANUFACTURERS (1941). 5000 pages, 9 by 14 inches. Published by M. Thomas Publishing Co., 461 Eighth Ave., New York City. Price, $15 ($10 to old subscribers).

This well-known directory of American manufacturers covers all the manufactured products in the United States. The arrangement is the same as in previous editions, comprising four main sections and two appendixes. The first section, or finding list, contains an index of all the products listed in the classified section. The second part, or classified section, which is the main part of the book covering 3934 pages and over 70,000 products, contains a list of manufacturers, classified according to their products, and sub-classified according to geographical locations. The next section consists of an alphabetical list of manufacturers, including, in many cases, home offices, branches, affiliations, succeeding concerns, etc. The leading trade names and brands of the products included in the classified section are listed in the final section. The first appendix covers banks, boards of trade, and other commercial organizations, and the second one gives a list of the leading trade papers. One of the valuable features of the book is the capital rating for each name, which is often useful in making a selection either for buying or selling.

This book, in its thirty-six years of publication, has proved of great value to purchasing agents, sales and research departments, and others concerned with specifying or buying, or who require names of American manufacturers in any line for any purpose. Those who have used this directory for a period of years can testify to the completeness and accuracy of the information.

MECHANISM. By Stanton E. Winston. 372 pages, 5 3/4 by 8 1/2 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $3.50.

This work covers the fundamental theory of the modification and transmission of motion. It has been brought out as a companion text to the author's previous book on "Machine Design," in order to cover the subject completely. The basic principles of the three ordinary methods of transmitting motion are developed, and a limited number of types of mechanisms in each class are studied. Graphical methods of analysis of these motions, rather than the algebraic method, are stressed. The text includes many illustrative examples and their solutions.

In writing this book, the author, who is associate professor of mechanical engineering at the Illinois Institute of Technology, has kept in mind the needs of the student, his aim being to present the subject matter so that it can be easily understood without help from any other source. It is assumed, however, that the student has a knowledge of elementary trigonometry and mechanical drawing.

ANALYTICAL MECHANICS FOR ENGINEERS. By Fred B. Seely and Newton E. Ensign. 450 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $3.75.

This is the third edition of a book on analytical mechanics written for the student of engineering. The principal change in the present edition consists of the addition of many new problems and figures. A new chapter has been added on mechanical vibrations in Part IV. The four parts into which the book is divided discuss, respectively, statics; kinematics; kinetics; and special topics, such as vibration, balancing, governors, etc. There are two appendixes dealing with moments of inertia. As in the second edition, a list of review questions and problems is given at the end of each chapter.

ELECTRICAL YEAR BOOK (1941). 332 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 31 King St., W., Manchester 3, England. Price, 2/ net.

This is the thirty-fourth year of publication of a little handbook for electrical engineers containing a collection of electrical engineering notes, rules, tables, etc. Among the new matter in the present edition is an explanation of the superimposed "ripple" developed for use with alternating-current circuits for exercising control at a distance. The subject of testing has received further attention, and new sections deal with regulations of the provisions for the electrical equipment of buildings, and the localization of cable faults.

TOLERANCES FOR CYLINDRICAL FITS. By John Gaillard. 24 pages; 17 graphs. Published by the American Standards Association, 29 W. 39th St., New York City. Price, 25 cents.

This booklet explains in simple terms the principles underlying the setting up of a standard system of fits, the control of fits by means of limit gages, and the accuracy requirements for the gages. It also reviews the status of national and international standardization in this particular field.

TRADE-NAMES INDEX. 178 pages, 7 by 10 inches. Published by the Special Libraries Association, 31 E. 10th St., New York City. Price, $4, plus postage.

This book contains an alphabetical list of 3496 trade names of materials, processes, and equipment having some technical significance. For each of these a definition is given, and usually a reference to a printed source of further information is cited. The volume also includes a record of more than one hundred other sources of information on trade names.

FIFTY HINTS FOR TEACHERS OF VOCATIONAL SUBJECTS. By M. R. Bass, director of the David Rankin School of Mechanical Trades, St. Louis, Mo. 46 mimeographed sheets, 5 1/2 by 8 1/2 inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, 50 cents.

DANGERS AND HEALTH HAZARDS OF FIRE GASES. By Harold Joe Davis. 16 pages, 6 by 9 inches. Published by the author at 3927 E. Admiral Place, Tulsa, Okla. Price, 25 cents.

* * *

Pratt & Whitney Aircraft Course for Draftsmen

To aid in meeting its urgent need for draftsmen—created by the increasing demands of the Defense Program—Pratt & Whitney Aircraft Division of United Aircraft Corporation announces its collaboration with the University of Connecticut in offering an intensive eight weeks' course of study. Twenty-five students were enrolled for the first session, which began March 17 at the Camp School in Hartford.

Instruction will be supplied jointly by Pratt & Whitney and the university, and will include courses in mechanical drawing, metallurgy, mathematics, and shop theory. While in full-time attendance during the forty-hour a week period, the student will be paid 50 cents an hour. Upon graduation, with qualification as a junior draftsman, he will be employed by the Pratt & Whitney Aircraft engineering department at a minimum salary of $120 a month.

This training program has been laid out to provide the necessary theoretical background as well as the practical knowledge of materials, processes, and graphical methods required of a draftsman.

Applicants must be American citizens at least eighteen years of age and must have had a minimum of four years' high-school mathematics. Preliminary applications are accepted by the Connecticut State Employment Commission in Hartford. Those approved are referred to the Pratt & Whitney employment office.